

Award Number:

W81XWH-09-1-0596

TITLE:

A Randomized Phase 2 Trial of ¹⁷⁷Lu Radiolabeled Anti-PSMA Monoclonal Antibody J591 in Patients With High-Risk Castrate, Biochemically Relapsed Prostate Cancer

PRINCIPAL INVESTIGATOR:

Scott T. Tagawa, MD

CONTRACTING ORGANIZATION:

Cornell University, Inc.
New York, NY 10021-4805

REPORT DATE: September 2017

TYPE OF REPORT:

ANNUAL

PREPARED FOR: U.S. Army Medical Research and Materiel Command

Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT:

Approved for public release; distribution unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

REPORT DOCUMENTATION PAGE				<i>Form Approved</i> OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) September 2017		2. REPORT TYPE Annual		3. DATES COVERED (From - To) 17Aug2016 - 16Aug2017	
4. TITLE AND SUBTITLE A Randomized Phase 2 Trial of 177Lu Radiolabeled Anti-PSMA Monoclonal Antibody J591 in Patients With High-Risk Castrate, Biochemically Relapsed Prostate Cancer				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER W81XWH-09-1-0596	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Scott Tagawa, MD Email: stt2007@med.cornell.edu				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Weill Cornell Medical College 1300 York Avenue New York, NY 10021				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT Clinical trial has received WCMC IRB and CTSC approval with enrollment of initial 6 subjects at WCMC. An additional 38 subjects enrolled (29 treated) at participating sub-sites. Reports submitted to WCMC DSMB in November 2016 with approval to proceed without modifications.					
15. SUBJECT TERMS Prostate cancer, PSA, PSMA, monoclonal antibody, radioimmunotherapy					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 131	19a. NAME OF RESPONSIBLE PERSON USARMC
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (include area code)

Table of Contents

	<u>Page</u>
Introduction.....	4
Body.....	4
Keywords.....	4
Accomplishments.....	4
Impact.....	5
Participants & Other Collaborating Organizations.....	7
Appendices.....	9

▪ **INTRODUCTION:**

Men with biochemically progressive (PSA only) prostate cancer have non-radiographically apparent micrometastases that may be targeted with radioimmunotherapy. Prostate specific membrane antigen (PSMA) is the single, most well-established, highly restricted prostate epithelial cell membrane antigen known and is expressed by virtually all prostate cancers. Investigators at WCMC have generated a high-affinity antibody (J591) against the external portion of PSMA that binds to viable PSMA-expressing cells and is internalized. Studies utilizing J591 radiolabeled with Lutetium-177 (^{177}Lu) have demonstrated safety, efficacy, and accurate, selective tumor targeting in the metastatic castration-resistant prostate cancer (CRPC) setting. The physical properties of ^{177}Lu are best suited for 1-3 mm tumors (those not seen on standard imaging modalities). The hypothesis is that the addition of ^{177}Lu -J591 to ketoconazole will improve time to radiographically apparent metastatic disease.

In this multi-center, double-blind, randomized phase II trial involving men with relapsed prostate cancer and biochemical only (PSA) progression (no radiographic evidence of metastases) despite castration at high risk of early development of metastases. The primary endpoint will be to compare the percentage of men with metastases at 18 months receiving ketoconazole plus ^{177}Lu -J591 vs ketoconazole plus trace-labeled ^{111}In -J591 (i.e. placebo). Secondary endpoints include PSA response, toxicity, progression-free survival, overall survival, the ability of radiolabeled J591 to image otherwise non-radiographically apparent metastatic sites, the prognostic and predictive capability of circulating tumor cells, baseline adrenal androgen levels, and circulating markers of hemostatic activation, fibrinolysis, and angiogenesis. Though initially designed as a larger study, with the introduction of newer hormonal therapy agents into the clinic and the known toxicity profile of radioimmunotherapy, the study was redesigned as follows. With a sample size of 50 (2:1 randomization), the study will have a ≥ 0.80 power with a pre-set alpha of 10% to determine an absolute difference in 18-month metastasis free survival between groups of 30%. An additional 10% will be enrolled to account for unevaluable subjects and loss to follow up (planned final n=55).

▪ **KEYWORDS:** Prostate cancer, PSA, PSMA, monoclonal antibody, radioimmunotherapy

▪ **ACCOMPLISHMENTS:**

▪ **What were the major goals of the project?**

- **Task 1: Completion of regulatory review, Clinical Trial Startup (Months 1 to 6)**
 - Milestone: Clinical trial approval at WCMC, Protocol approval by ORP, Initiation of approved study
- **Task 2: Clinical trial Start up at additional sites (Months 1-96)**
 - Milestone: Trial approval at all initially planned sites. In the past year, two additional sites have been approved and currently there are two additional sites in the start-up process.
- **Task 3: Completion of initial (safety) cohort (Months 1-24)**
 - Milestones: Enrollment of initial 9 subjects; review of safety data by DSMB completed.
- **Task 4: Clinical trial performance (Months 1-96)**

- Milestones: Enrollment of initial 30 subjects by 12/31/14, 50 subjects are planned by 12/31/17 and as of 08/2017 48 subjects have been enrolled. All subjects are planned to be enrolled by 12/31/2018; completion of annual renewals
- **Task 5: Investigator analysis, reporting of initial data (Months 25-96+)**
 - Milestones: Reporting of initial data (correlatives) in abstract form (goal = ASCO 2018)
- **Task 6: Analysis and reporting of final data (Month 96+)**
 - Milestones: Reporting of additional preliminary data (PSA response, toxicity, biochemical progression, additional correlative studies) ASCO 2018. Post-award reporting of primary endpoint (goal ASCO 2019) followed by publication in manuscript form.

▪ **What was accomplished under these goals?**

At the end of this reporting period, a cumulative total of 48 patients were enrolled to this study. During this reporting period, 2 subjects were enrolled and follow up continued on other subjects with ongoing queries to the individual sites. Two new investigational sites have also opened this study at their site, and additional sites are being recruited.

▪ **What opportunities for training and professional development has the project provided?**

Nothing to Report.

▪ **How were the results disseminated to communities of interest?**

Nothing to Report.

▪ **What do you plan to do during the next reporting period to accomplish the goals?**

Additional sites are actively being recruited and advertising efforts have increased.

▪ **IMPACT:**

▪ **What was the impact on the development of the principal discipline(s) of the project?**

Nothing to Report.

▪ **What was the impact on other disciplines?**

Nothing to Report.

▪ **What was the impact on technology transfer?**

Nothing to Report.

▪ **What was the impact on society beyond science and technology?**

Nothing to Report.

▪ **CHANGES/PROBLEMS:**

▪ **Changes in approach and reasons for change**

Accrual has been slow for a number of reasons, including the rarity of the patient population (the high-risk subset) and the low per-subject reimbursement being offered to sites on a federally funded study (as compared to pharmaceutical-sponsored). Therefore, after discussions with the site PI's,

additional key opinion leaders, and statisticians, an amendment was introduced as below: The amended statistical design was reviewed and approved from the DSMB and IRB. Please find approved justification listed below:

The study is a randomized phase 2 study with a 2:1 ratio favoring 177Lu-J591, with stratification by investigational site and mode of primary therapy (radiation vs surgery). Randomization will be performed by using a series of randomized blocks of 6 within each participating site/primary therapy stratum (with a 2:1 allocation ratio). This will provide assurance that after six patients are enrolled in any given participating site/primary therapy stratum, there will be four patients assigned to the combination regimen (Group 1) and two patients assigned to the single regimen (Group 2). This procedure will allow for each site to contribute similar numbers of 177Lu-J591/ketoconazole patients and 111In-J591 (placebo)/ketoconazole patients within the defined participating site/primary therapy strata.

The primary endpoint is the proportion free of metastases in each group at 18 months. Ninety-five percent confidence intervals (95% CI) will be estimated for the 18-month MFS proportion in both groups via binomial proportions. The MFS proportion will also be descriptively evaluated at 12, 24, 30, and 36 months in each group.

MFS will be measured from the start of the treatment to the date of either documentation of metastatic disease or death. All treated patients will be observed for a minimum of 18 months. The 18-month MFS proportion with ketoconazole + 111In-J591 has been estimated to be 50%; therefore, the target 18-month MFS proportion for the combination of ketoconazole + 177Lu-J591 regimen is hypothesized to be 80%. An intent to treat analysis will include all randomized subjects. However, we will also analyze subjects who received study-drug. This subset will be those subjects who met eligibility requirements, have initiated therapy, and were not removed from the study for non-compliance or patient withdrawal within the first 4 weeks, and received infusion of study drug.

With approximately 34 patients in the ketoconazole+J591 arm and 17 patients in the ketoconazole monotherapy arm (2:1 allocation), this design will allow for the detection of a 30% absolute difference in the 18-month MFS proportion between the ketoconazole+J591 arm and the ketoconazole monotherapy arm (80% vs. 50%, respectively) with greater than or equal to 80% power and a one-sided alpha level of 10%. An additional 10% will be enrolled to account for loss to follow up (total projected 3 number of subjects to be randomized = 55). A 95% CI for the difference in the 18-month MFS proportion between the two treatment arms can be constructed to be within plus or minus 18% of the true difference in 18-month MFS proportions.

The planned sample size is 55 subjects (50 + 10% for in-evaluable / loss to follow-up = 55). Subjects who come off protocol prior to day 29 of treatment (i.e. prior to infusion of study drug) will be replaced. It is anticipated that the average site will pre-screen several subjects per month and enroll approximately 3 subjects per year.

Patients will be stratified by treating institution and delivery of primary therapy (surgery and/or radiotherapy vs no primary therapy to the prostate)."

Since the implementation of the above detailed amendment, we have opened this study in two additional sites, and currently in the start-up process for two additional site. We expect these additional sites to increase subject enrollment.

- **Actual or anticipated problems or delays and actions or plans to resolve them**

As above, plan is to identify additional sites

- **Changes that had a significant impact on expenditures**

No significant changes.

- **Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents**

- **Significant changes in use or care of human subjects**

An amendment to the protocol, reducing patient sample size from 140 individuals to 55 was approved by the IRB on 1/26/2016. Most recent IRB approval of protocol #0810010067 was received on 10/18/17.

- **Significant changes in use or care of vertebrate animals.**

Not applicable.

- **Significant changes in use of biohazards and/or select agents**

Not applicable.

▪ **PRODUCTS:**

- **Publications, conference papers, and presentations:**

- **Journal publications.**

Nothing to report.

- **Books or other non-periodical, one-time publications.**

Nothing to report.

- **Other publications, conference papers, and presentations.**

Nothing to report.

- **Website(s) or other Internet site(s)**

<https://clinicaltrials.gov/ct2/show/NCT00859781>

- https://jcto.weill.cornell.edu/open_clinical_trials/a-randomized-phase-2-trial-of-177lu-radiolabeled-monoclonal-antibody-huj591-177lu-j591-and-ketoconazole-in-patients-with-high-risk-castrate-biochemically-relapsed-prostate-cancer-after-local-therapy

- **Technologies or techniques**

Nothing to report.

- **Inventions, patent applications, and/or licenses**

Nothing to Report.

- **Other Products**

Nothing to Report.

▪ **PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS**

- **What individuals have worked on the project?**

Name:	Scott Tagawa, M.D.
Project Role:	Principal Investigator
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	2

Contribution to Project:	Study design, recruitment, Treatment, assessment of subjects Data analysis and reporting
Funding Support:	DoD W81XWH-09-1-059

Name:	<i>Amy Hackett</i>
Project Role:	<i>Program Specialist</i>
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	<i>1</i>
Contribution to Project:	Data entry and queries Communication with sites
Funding Support:	DoD W81XWH-09-1-059

Name:	<i>Jyothi Sreekumar</i>
Project Role:	<i>Clinical Research Coordinator</i>
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	<i>1</i>
Contribution to Project:	Communication with sites and agencies
Funding Support:	DoD W81XWH-09-1-059

- **Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?**

Scott Tagawa, M.D.

Dr. Tagawa received the following new funding in the past year:

PCF Challenge Award (Tagawa/Bander/Vallabhajosula)

Title: Optimization of prostate-specific membrane antigen-targeted radiation

Time Commitment: 1.2 calendar

Supporting Agency: Prostate Cancer Foundation

Grants Officer: Howard R. Soule, Prostate Cancer Foundation; email: hsoule@pcf.org

Performance Period: 10/1/2017– 09/30/2019

Level of Funding: \$444,367

Goals: To optimize the early-stage development of PSMA-targeted ¹⁷⁷Lu and set the stage for continued development of PSMA-targeted alpha emitters. Aims: 1. To optimize dose and schedule of PSMA-targeted ¹⁷⁷Lu, we will prospectively study the most commonly used PSMA small molecule and optimize therapy with dose-fractionation. 2. To prospectively and retrospectively assess the optimal patient population to receive ¹⁷⁷Lu-radiolabeled PSMA agents. 3. To complete a phase I dose-escalation study of ²²⁵Ac-J591 with the primary endpoint of dose-limiting toxicity and MTD determination followed by expansion at the recommended phase 2 dose cohort to gain additional safety experience as well as preliminary efficacy data.

Movember-PCF Challenge Award (Lang/Scher/Dehm/Tagawa)

Title: Therapeutic Targeting of AR Variant Prostate Cancer with a Novel Antibody Drug Conjugate

Time Commitment: 1.2 calendar

Supporting Agency: Prostate Cancer Foundation

Grants Officer: Howard R. Soule, Prostate Cancer Foundation; email: hsoule@pcf.org

Performance Period: 08/31/2017– 08/31/2019

Level of Funding:

Goals/Aims: To evaluate and validate Trop2 biomarkers, to treat patients with IMMU-132, and to evaluate predictive and pharmacodynamic biomarker assays of response and resistance to IMMU-132.

Role: Co-Principal Investigator

WCMC SPORE Initiative (Tagawa/Bander/Vallabhajosula)

Title: PSMA-targeted alpha-radioimmunotherapy with 225Ac-J591

Time Commitment: 0 calendar

Supporting Agency: Weill Cornell Medicine Meyer Cancer Center

Contracting Officer: Kate Carbonell, Research Program Manager, WCM, 646-962-6165, kac2051@med.cornell.edu

Performance Period: 04/1/2017 – 03/31/2018

Level of Funding:

Project Goals/Aims: Aims: 1) to complete preclinical studies and obtain IND for 225Ac-J591 and 2) to initiate a phase I dose-escalation study of single-dose 225Ac-J591 in men with metastatic castration-resistant prostate cancer

Role: Co-Principal Investigator

Dr. Tagawa had this DoD award (W81XWH-09-1-0596) end in August and the following additional project end in the past year:

NYS DOH Research Grant (Tagawa/Giannakakou)

Title: Molecular Determinants of Response and Resistance to Taxanes and Androgen Deprivation Therapy in Castration-Resistant Prostate Cancer

Supporting Agency: New York State Department of Health

Contracting Officer: N/A

Performance Period: 11/01/2015- 01/31/2017

Level of Funding:

Project Goals/Aims: This project aims to perform molecular profiling of PC-patient derived CTCs.

Role: Co-Principal Investigator

- **What other organizations were involved as partners?**

Nothing to report

- **SPECIAL REPORTING REQUIREMENTS**

- **COLLABORATIVE AWARDS:** Not applicable
- **QUAD CHARTS:** Not Applicable

- **APPENDICES:**

Appendix A: Revised Statement of Work, 6/30/2014 (3rd NCE Request)

Appendix B: Revised Statement of Work, 4/13/17

Appendix C: Protocol 0810010067, version 9 (approved: 01/26/2016)

Appendix D: IRB Approval, 10/19/16

Appendix E: Letters regarding funding structure for project – DoD and non-DoD funding commitments and plans

Appendix F: Letter of funding commitment, Neil Bander

Appendix G: IRB Approval

Task 1: Completion of regulatory review, Clinical Trial Startup (Months 1 to 6)

- a. Completion of amendment incorporating CDMRP
- b. Approval of protocol by ORP
- c. Initiation of approved protocol at WCMC

Milestone: Clinical trial approval at WCMC, Protocol approval by ORP, Initiation of approved study

Task 2: Clinical trial Start up at additional sites (Months 1-40)

- a. Site selection
 1. Obtain agreement to participate with additional institutions
- b. Start up at additional sites. At each site:
 1. Scientific committee, IRB, and radiation safety submission
 2. Scientific, IRB, radiation safety approval
 3. Inter-institutional agreement approval
 4. Site initiation visit

Milestone: Trial approval at all sites

Task 3: Completion of initial (safety) cohort (Months 1-24)

- a. Screen, enroll, and treat up to 9 subjects who complete at least 3 months of follow up
- b. Ongoing communication by WCMC with IRB, DSMB, FDA, etc.
- c. Submit initial data for review by DSMB

Milestones: Enrollment of initial 9 subjects; review of safety data by DSMB

Task 4: Clinical trial performance (Months 1-72)

- a. Screen, enroll, and treat up to 140 subjects
 1. Anticipate accrual of 3-6 subjects per year per site
 2. Once all sites are activated, anticipate enrollment of 3-6 subjects per month
- b. Ongoing communication with study sites
 1. Real time communication via electronic email, phone, electronic CRF's
 2. Queries via email, fax, phone, electronic submission
 3. Monthly conference calls with site PI's and study personnel
 4. Site visits when deemed necessary
- c. Ongoing communication by WCMC with IRB, DSMB, FDA, etc.
 1. Real time updates on adverse events
 2. At least semi-annual DSMB review

Milestones: Enrollment of initial 50 subjects by 12/31/14, 100 subjects by 12/31/15, all subjects by 12/31/2016; completion of annual renewals

Task 5: Interim analysis (Approximately months 60-65)

- a. Verification of data
 1. Completion of queries to study sites
 2. Site visits when deemed necessary
- b. Compilation of data to DSMB for review

Milestone: Review of interim analysis

Task 6: Investigator analysis, reporting of initial data (Months 25-72+)

- a. Verification of data
 - 1. Completion of queries to study sites
 - 2. Site visits when deemed necessary
 - b. Analysis of initial data
 - 1. Demographic data
 - 2. Toxicity data
 - 3. PSA response
 - 4. Adrenal androgen levels
 - 5. Plasma markers of hemostasis, fibrinolysis, angiogenesis
 - 6. Circulating tumor cells
 - c. Reporting of initial data
- Note:* Analysis of secondary endpoint related to treatment with ketoconazole (while remaining blinded to study drug) as well as reporting of this data will occur prior to study completion

Milestones: Reporting of initial data (correlatives) in abstract form (goal = ASCO 2016)

Task 7: Analysis and reporting of final data (Month 72+)

- a. Verification of data
 - 1. Completion of queries to study sites
 - 2. Site visits when deemed necessary
- b. Analysis of data
 - 1. Demographic data
 - 2. Toxicity data
 - 3. Metastasis free proportion, metastasis free survival
 - 4. J591 Imaging
 - 5. PSA response
 - 6. Time to PSA progression
 - 7. Circulating tumor cells
- c. Reporting of final data in abstract form
- d. Manuscript submission

Milestones: Reporting of additional preliminary data (PSA response, toxicity, biochemical progression, additional correlative studies) ASCO 2016. Post-award reporting of primary endpoint (goal ASCO 2017) followed by publication in manuscript form.

Task 1: Completion of regulatory review, Clinical Trial Startup (Months 1 to 6)

- a. Completion of amendment incorporating CDMRP
- b. Approval of protocol by ORP
- c. Initiation of approved protocol at WCMC

Milestone: Clinical trial approval at WCMC, Protocol approval by ORP, Initiation of approved study

Task 2: Clinical trial Start up at additional sites (Months 1-96)

- a. Site selection
 1. Obtain agreement to participate with additional institutions
- b. Start up at additional sites. At each site:
 1. Scientific committee, IRB, and radiation safety submission
 2. Scientific, IRB, radiation safety approval
 3. Inter-institutional agreement approval
 4. Site initiation visit

Milestone: Trial approval at all sites

Task 3: Completion of initial (safety) cohort (Months 1-24)

- a. Screen, enroll, and treat up to 9 subjects who complete at least 3 months of follow up
- b. Ongoing communication by WCMC with IRB, DSMB, FDA, etc.
- c. Submit initial data for review by DSMB

Milestones: Enrollment of initial 9 subjects; review of safety data by DSMB

Task 4: Clinical trial performance (Months 1-96)

- a. Screen, enroll, and treat up to 55 subjects
 1. Anticipate accrual of 3-6 subjects per year per site
 2. Once all sites are activated, anticipate enrollment of 3-6 subjects per month
- b. Ongoing communication with study sites
 1. Real time communication via electronic email, phone, electronic CRF's
 2. Queries via email, fax, phone, electronic submission
 3. Monthly conference calls with site PI's and study personnel
 4. Site visits when deemed necessary
- c. Ongoing communication by WCMC with IRB, DSMB, FDA, etc.
 1. Real time updates on adverse events
 2. At least semi-annual DSMB review

Milestones: Enrollment of initial 30 subjects by 12/31/14, 50 subjects by 12/31/15, all subjects by 12/31/2016; completion of annual renewals

Task 5: Interim analysis (REMOVED FROM PROJECT PLANS)

- a. Verification of data
 1. Completion of queries to study sites
 2. Site visits when deemed necessary
- b. Compilation of data to DSMB for review

Milestone: Review of interim analysis

Task 6: Investigator analysis, reporting of initial data (Months 25-96+)

- a. Verification of data
 - 1. Completion of queries to study sites
 - 2. Site visits when deemed necessary
 - b. Analysis of initial data
 - 1. Demographic data
 - 2. Toxicity data
 - 3. PSA response
 - 4. Adrenal androgen levels
 - 5. Plasma markers of hemostasis, fibrinolysis, angiogenesis
 - 6. Circulating tumor cells
 - c. Reporting of initial data
- Note:* Analysis of secondary endpoint related to treatment with ketoconazole (while remaining blinded to study drug) as well as reporting of this data will occur prior to study completion

Milestones: Reporting of initial data (correlatives) in abstract form (goal = ASCO 2016)

Task 7: Analysis and reporting of final data (Month 96+)

- a. Verification of data
 - 1. Completion of queries to study sites
 - 2. Site visits when deemed necessary
- b. Analysis of data
 - 1. Demographic data
 - 2. Toxicity data
 - 3. Metastasis free proportion, metastasis free survival
 - 4. J591 Imaging
 - 5. PSA response
 - 6. Time to PSA progression
 - 7. Circulating tumor cells
- c. Reporting of final data in abstract form
- d. Manuscript submission

Milestones: Reporting of additional preliminary data (PSA response, toxicity, biochemical progression, additional correlative studies) ASCO 2016. Post-award reporting of primary endpoint (goal ASCO 2017) followed by publication in manuscript form.



Weill Cornell Medical College

IRB Protocol Number: 0810010067
Randomized Phase II: LuJ591+Ketoconazole
Protocol Version 9 Dated: 26 January 2016

A Randomized Phase 2 Trial of ^{177}Lu Radiolabeled Monoclonal Antibody HuJ591 (^{177}Lu -J591) and Ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy

Study Chair:

Scott T. Tagawa, M.D.
Division of Hematology/Medical Oncology
Weill Cornell Medical College
525 East 68th Street,
New York, NY 10065
Tel: 646-962-2072
Fax: 646-962-1603
stt2007@med.cornell.edu

Protocol Version 1 Dated: September 08, 2008
Protocol Version 2 Dated: October 28, 2009
Protocol Version 3 Dated: January 15, 2010
Protocol Version 4 Dated: May 25, 2010
Protocol Version 5 Dated: June 01, 2011
Protocol Version 6 Dated: July 02, 2012
Protocol Version 7 Dated: October 31, 2013
Protocol Version 8 Dated: May 4, 2015
Protocol Version 9 Dated: January 26, 2016

Co-Investigators:

**Weill Cornell Medical College-
NewYork-Presbyterian Hospital
Division of Hematology & Medical Oncology
525 E. 68th St., Starr 3 New York, NY 10065**

David Nanus, M.D.
Caryn Ecker, NP
Himisha Beltran, M.D.
Ana Molina, M.D.
Meghan Moran, NP

Co-Investigators:

**Weill Cornell Medical College-
NewYork-Presbyterian Hospital
Division of Nuclear Medicine
525 E. 68th St., Starr 2, New York, NY 10065**

Stanley Goldsmith, M.D.
Shankar Vallabhajosula, Ph.D.
Honglei Zhang, M.D.
Yuliya Jhanwar, M.D.
Trisha Youn, M.D.

Statistician:

Paul Christos, DrPH
Weill Cornell Medical College
Division of Biostatistics and Epidemiology
pac2001@med.cornell.edu

Coordinating Research Nurse:

Lauren Emmerich, R.N.
Weill Cornell Medical College
Tel: (212) 746-1851
Fax: (212) 746-8698
lae9024@med.cornell.edu

Global Project Manager:

Irene Karpenko
Weill Cornell Medical College
425 East 61st St, Suite 201
New York, NY 10065
Tel: (646) 962-9346
Fax: (646) 962-1611
Irk2006@med.cornell.edu

Study email address:

guonc@med.cornell.edu

(no attachments >4.5 MB)

INVESTIGATOR AGREEMENT

Protocol Version 9.0 Dated: 26 January 2016

I have read the protocol entitled “A Randomized Phase 2 Trial of ^{177}Lu Radiolabeled Monoclonal Antibody HuJ591 (^{177}Lu -J591) and Ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy.”

I agree to conduct the study as detailed herein and in compliance with ICH Guidelines for Good Clinical Practice and applicable regulatory requirements and to inform all who assist me in the conduct of this study of their responsibilities and obligations.

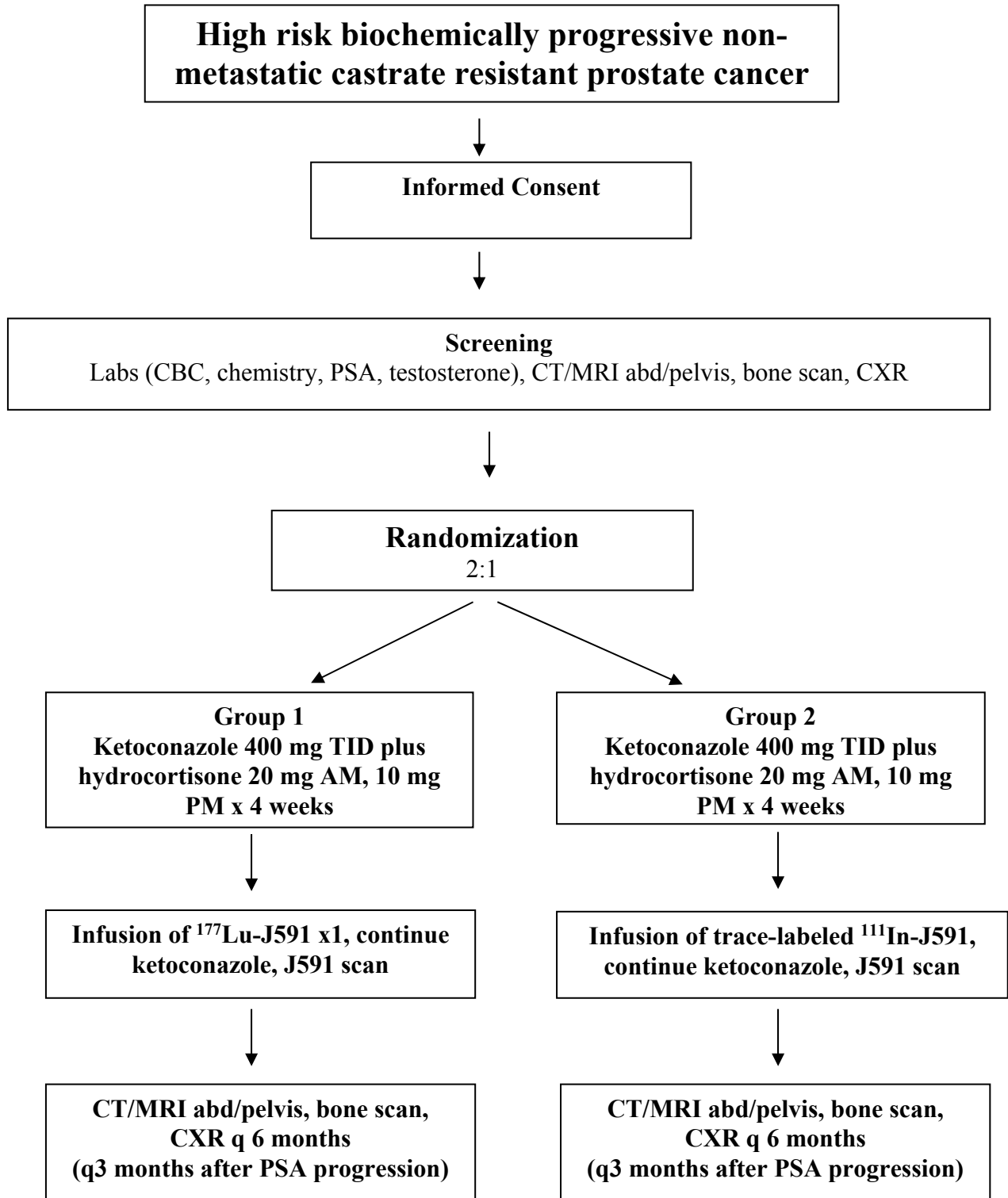
Principal investigator printed name

Principal investigator signature

Date

Investigational site or name of institution and location (printed)

SCHEMA



PROTOCOL SUMMARY

Study Title:	A Randomized Phase 2 Trial of ^{177}Lu Radiolabeled Monoclonal Antibody HuJ591 (^{177}Lu-J591) with Ketoconazole in Patients with High Risk Castrate Biochemically Relapsed Prostate Cancer after Local Therapy
Principal Investigator:	Scott T. Tagawa, MD (New York Presbyterian Hospital-Weill Cornell Medical College)
Number of Study Centers Planned:	10-16
Clinical Phase:	Phase 2 (Randomized)
Study Rationale:	To determine the clinical activity of ^{177}Lu -J591 with ketoconazole for the treatment of patients with castrate resistant biochemically progressive prostate cancer
Study Objectives:	<p style="text-align: center;">Primary Objective</p> <p>Compare the rate of progression to radiographically apparent metastatic disease at 18 months with ^{177}Lu-J591 plus ketoconazole versus ketoconazole plus trace-labeled ^{111}In-J591 (placebo)</p> <p style="text-align: center;">Secondary & Exploratory Objectives</p> <ul style="list-style-type: none"> • Compare progression free and metastasis free survival • Define the PSA response rate (50% reduction, with 30% reduction exploratory analysis). • Define the duration of PSA response • Define the toxicity of ^{177}Lu-J591 given as single dose plus ketoconazole in men with castrate resistant biochemical disease. • Assess the overall and prostate cancer specific survival rate of patients following treatment. • Assess the prognostic implications of baseline adrenal hormone levels in men with castrate resistant non-metastatic prostate cancer receiving ketoconazole • Define the toxicity and need for dose modifications with “high dose” ketoconazole in men with biochemically progressive castrate resistant prostate cancer • To explore the ability of ^{177}Lu-J591 or ^{111}In-J591 to image metastatic sites in patients who are NED on bone scan CT/MRI of abdomen/pelvis and CXR (selected sites) • To assess the prognostic implications of baseline circulating tumor cell (CTC) counts in men with castrate resistant non-metastatic prostate cancer receiving ketoconazole and to explore the implications of serial

	<p>changes in CTC counts (centrally assessed, optional)</p> <ul style="list-style-type: none"> • To explore the feasibility of quantitative assessment of PSMA expression in CTCs and explore prognostic and predictive implications of PSMA expression in circulating tumor cells prior to therapy with Lu-J591 (centrally assessed, optional) • To assess the implications and changes with therapy of plasma markers of hemostasis, fibrinolysis, and angiogenesis in biochemically progressive castrate resistant prostate cancer (centrally assessed, optional. • To describe reasons for lack of participation in study treatment • To assess patient reported outcomes in the setting of non-metastatic CRPC and with the development of metastases
Methodology:	<p>Subjects will be randomized in a 2:1 fashion to receive ketoconazole with 70 mCi/m² of ¹⁷⁷Lu-J591 or trace-labeled ¹¹¹In-J591. Subjects will be stratified by site and method of primary therapy (surgery vs radiation). All subjects will receive ketoconazole (400 mg po TID) plus hydrocortisone (20 mg am, 10 mg pm) for 4 weeks followed by a single infusion of ¹⁷⁷Lu-J591 or trace-labeled ¹¹¹In-J591, then continue ketoconazole/hydrocortisone until progression/toxicity. Patients will be followed for response (biochemical), disease progression, and toxicity with the primary endpoint of time to radiographically apparent metastatic disease</p>
Number of Patients Planned:	55
Statistical Methods	<p>Based upon entry criteria, we expect 50% of patients to have developed metastasis at 18 months with ketoconazole + ¹¹¹In-J591. With a sample size of 50 (2:1 randomization), the study will have ≥80% power, with a pre-set one sided alpha of 10%, to determine an absolute difference in the 18-month metastasis-free survival (MFS) between groups of 30% (e.g., 80% vs 50%). An additional 10% will be enrolled to account for unevaluable subjects and loss to follow-up, resulting in a planned final n = 55.</p>

TABLE OF CONTENTS

SCHEMA	iv
PROTOCOL SUMMARY	v
1. OBJECTIVES	1
1.1 Primary Objectives	1
1.2 Secondary Objectives	1
1.3 Exploratory Objectives	1
2. BACKGROUND	2
2.1 Disease	2
2.2 Investigational Agent	7
2.3 Rationale	13
2.4 Correlative Studies Background	13
3. PATIENT SELECTION	18
3.1 Inclusion Criteria	18
3.2 Exclusion Criteria	19
4. ENROLLMENT & REGISTRATION PROCEDURES	21
4.1 Enrollment Procedures	21
4.2 Central Patient Registration	22
5. TREATMENT PLAN	23
5.1 Agent Administration	23
5.2 General Concomitant Medication and Supportive Care Guidelines	24
5.3 Duration of Therapy and Criteria for Removal from Study	26
5.4 Duration of Follow Up	26
6. DOSING DELAYS/DOSE MODIFICATIONS	26
7. ADVERSE EVENTS: LIST AND REPORTING REQUIREMENTS	27
7.1 Comprehensive Adverse Events and Potential Risks List (CAEPR)	27
7.2 Adverse Event Characteristics	28
7.3 Recording of Adverse Events	29
7.4 Serious Adverse Event Reporting	29
7.5 Secondary AML/MDS	30
8. AGENT INFORMATION	31
8.1 Investigational Agent (IND#11,613): J591	31
8.2 Agent Ordering	31
8.3 Drug Accountability	31
9. CORRELATIVE/SPECIAL STUDIES	32
9.1 Laboratory Correlative Studies	32

9.2	Special Studies	34
10.	STUDY CALENDAR	35
10.1	Study Procedures	37
11.	MEASUREMENT OF EFFECT	46
11.1	Metastasis-Free Proportion	46
11.2	Response Criteria	46
12.	DATA REPORTING / REGULATORY CONSIDERATIONS	47
12.1	Data Collection	47
12.2	Regulatory Considerations	47
12.3	DSMB	48
12.4	Initial Safety Review	49
12.5	Analysis and Reporting	49
13.	STATISTICAL CONSIDERATIONS	49
14.	INCLUSION OF WOMEN AND MINORITIES	52
15.	STUDY PERSONNEL	52
16.	FUNDING	54
17.	ADDITIONAL STUDY SITES	55
REFERENCES		56
APPENDICES		
APPENDIX A		
	Performance Status Criteria	64
APPENDIX B		
	Stopping Rules	65
APPENDIX C		
	% Skeleton for Radiotherapy	66
APPENDIX D		
	Department of Defense Language	67
APPENDIX E		
	Radiographic Guidelines	70
APPENDIX F		
	Ketoconazole substitution (ex-U.S.)	71

APPENDIX G	
FACT-P	72
APPENDIX H	
PIRADS v2	

1. OBJECTIVES

1.1. Primary Objectives

To compare the rate of progression to radiographically apparent metastatic disease at 18 months with ^{177}Lu -J591 plus ketoconazole versus trace-labeled ^{111}In -J591 plus ketoconazole.

1.2. Secondary Objectives

To define the PSA response rate (50% reduction, with 30% reduction exploratory analysis).

To define the duration of PSA response

To define the toxicity of ^{177}Lu -J591 given as single dose plus ketoconazole in men with castrate resistant biochemical disease.

To assess the overall and prostate cancer specific survival rate of patients following treatment.

To define the toxicity and need for dose modifications with “high dose” ketoconazole in men with biochemically progressive castrate resistant prostate cancer

To assess the prognostic implications of baseline adrenal hormone levels in men with castrate resistant non-metastatic prostate cancer receiving ketoconazole

To explore the ability of ^{177}Lu -J591 to image metastatic sites in patients who are NED on bone scan CT/MRI of abdomen/pelvis and CXR (selected study sites)

To assess the changes with therapy and implications of plasma markers of hemostasis, fibrinolysis, and angiogenesis in biochemically progressive castrate resistant prostate cancer (optional)

To assess patient reported outcomes with high-risk, non-metastatic CRPC and with the development of metastases

1.3 Exploratory Objectives

To assess the prognostic implications of baseline circulating tumor cell (CTC) counts in men with castrate resistant non-metastatic prostate cancer receiving ketoconazole and to explore the implications of serial changes in CTC counts

To explore the prognostic and predictive implications of PSMA expression in circulating tumor cells

To explore the prognostic and predictive implications of PSMA expression in archival surgical or biopsy material in subjects being treated with anti-PSMA RIT

To describe reasons for lack of participation in study treatment (i.e. reasons for pre-screen and screen failures)

2. BACKGROUND

2.1 Disease

Prostate cancer is the leading cause of noncutaneous cancer in men in the United States, accounting for 29% of all cancers with 218,890 estimated new cases in 2007 (1). It is the second leading cause of cancer-related death, with 27,050 US men estimated to die from this disease in 2007(1). Clinically localized adenocarcinoma of the prostate is treated primarily with surgery or radiation therapy, with or without hormonal or chemotherapy, although another option for some men with newly diagnosed prostatic adenocarcinoma is active surveillance or observation, since some men will continue to be asymptomatic until death from another cause (2, 3). Although therapy for localized disease may be successful at eradicating the disease, some patients suffer recurrence or present with advanced disease. First line therapy for advanced adenocarcinoma of the prostate usually includes androgen deprivation with a mean duration of efficacy of 12-18 months (4), although there is a wide variation in response in this heterogeneous disease.

Unfortunately, after primary therapy with surgery or radiotherapy, some men suffer relapsed disease. In the current PSA era, the majority of these relapses are initially “biochemical” only, i.e. with a rising PSA despite no evidence of cancer on scans (5, 6), affecting approximately 50,000 or more men per year in the U.S. alone. Some of these men may be “salvaged” with appropriate therapy for local relapse (radiation for those that had surgery first, and surgery or cryotherapy for those with locally relapsed disease after radiotherapy) (6). Although there is no proven overall survival benefit in a prospective randomized trial, radiotherapy as a salvage regimen after radical prostatectomy can lead to long-term survival in selected individuals (7-10).

However, most patients who receive local or regional radiotherapy with the hopes of cure after biochemical relapse following surgery subsequently suffer systemic progression. We have demonstrated J591-based therapy’s ability to successfully target known sites of disease and have positive signals of ¹⁷⁷Lu-J591’s efficacy in the advanced setting (see below). Since forms of radiotherapy have been validated in the clinically localized as well as salvage setting, “targeted radiotherapy” in the form of radioimmunotherapy is at least theoretically an attractive option with the possibility of even greater efficacy in the minimal disease (biochemical only) setting. The most studied form of radioimmunotherapy to date uses targeting of the CD20 antigen (I¹³¹ tositumomab and Y⁹⁰ ibritumomab tiuxetan) in non-Hodgkin’s lymphoma. While approved in the relapsed setting, it appears that these therapies have their greatest impact in the minimal disease setting (11-16). In addition, the decay characteristics of ¹⁷⁷Lu with its relatively short range beta emission is preferably suited for small volume, rather than bulky, disease sites.

Prostate specific membrane antigen

Prostate specific membrane antigen (PSMA) is the single, most well-established, highly restricted prostate epithelial cell membrane antigen known (17-22). The PSMA gene has been cloned, sequenced, and mapped to chromosome 11p (18, 23). Although first thought to be entirely prostate-specific (17-19), subsequent studies demonstrated that PSMA is also expressed by cells of the small intestine, proximal renal tubules and salivary glands (21). However, the

level of expression in these non-prostate tissues is 100-1000-fold less than in prostate tissue (22), and the site of PSMA expression in these normal cells (brush border/luminal location) are not typically exposed to circulating Ab. In contrast to other well known prostate-restricted molecules such as PSA and prostatic acid phosphatase (PAP) that are secretory proteins, PSMA is a type II integral cell-surface membrane protein that is not secreted, thereby making PSMA an ideal target for mAb therapy. Pathology studies indicate that PSMA is expressed by virtually all prostate cancers (23). Moreover, PSMA expression increases progressively in higher grade cancers, metastatic disease and hormone-refractory prostate cancer (19, 20, 24, 25).

PSMA has been found to have folate hydrolase and neurocarboxypeptidase activity (26). Although its role in PC biology is unknown, the consistent finding of PSMA upregulation correlating with increased aggressiveness of the cancer implies that PSMA has a functional role in PC progression. Inhibition of enzymatic activity *in vitro* or in xenograft models has not demonstrated significant growth inhibitory effect (27). Nevertheless, the expression pattern of PSMA makes it an excellent target for mAb based targeted therapy of prostate cancer.

PSMA as a target in prostate cancer

Use of capromab penditide (Prostascint ®) has validated PSMA as an *in vivo* target for imaging (28, 29), although clinical treatment studies with capromab have been disappointing (30, 31). Molecular mapping revealed that capromab targets a portion of the PSMA molecule that is within the cell's interior and not exposed on the outer cell surface (32-34) and cannot bind to viable cells (17, 34). Recognition of these features led Neil Bander at WCMC and others to propose that mAbs to the exposed, extracellular domain of PSMA had the potential to significantly improve *in vivo* targeting likely resulting in enhanced imaging and therapeutic benefit (34, 35). These antibodies (J591, J415, J533 and E99) demonstrate high affinity binding to viable PSMA-expressing LNCaP cells in tissue culture and are rapidly internalized (34, 36).

Pre-clinical experience with J591

Murine monoclonal Ab J591 (muJ591) was chosen for clinical development and has been extensively studied in pre-clinical models (37-39). The affinity of J591 is 1 nM which other studies have shown to be the optimal affinity in therapeutic models, lower affinity providing less binding and higher affinity interfering with antibody penetration into tumor masses (40).

Immunohistochemistry studies with mAbs to PSMA_{ext} confirmed the highly restricted expression pattern of PSMA with binding to prostate epithelial cells and weak binding to the brush border of renal proximal tubular and small bowel epithelium. Unexpectedly, immunohistochemical studies of a variety of malignant tissues found that tumor vascular endothelium of all solid tumors, but not normal vascular endothelium, bound anti-PSMA antibodies (34). This further raised the interest in anti-PSMA antibodies as a potential way to specifically target not just prostate cancer but all solid tumors using a vascular targeting approach.

Animal studies utilized nude mice implanted subcutaneously with PSMA-expressing LNCaP cells. After allowing the tumors to establish and reach a diameter of 7-10 mm, the animals were treated with J591 radiolabeled with different isotopes, including ¹³¹Iodine (¹³¹I-J591), ¹⁷⁷Lutetium (¹⁷⁷Lu-J591) and ⁹⁰Yttrium (⁹⁰Y-J591). These studies showed that ⁹⁰Y and ¹⁷⁷Lu provide better dosimetry due to their longer intracellular half-lives and radioiodine's

relatively rapid clearance and that anti-tumor responses were seen with all radionuclides with an apparent dose response relationship. Higher cumulative doses of either ^{90}Y or ^{177}Lu could be delivered using fractionated dosing (multiple sub-MTD doses rather than a single MTD dose). Median survival of the animals improved by 300% for fractionated ^{90}Y -J591 therapy (150 days vs. 52 days (control)). With fractionated dose ^{177}Lu -J591, >80% of the mice were cured (39). A major limitation of using a mouse mAb in patients is the development of a human anti-mouse antibody (HAMA) response that precludes repetitive dosing. Therefore, mAb J591 was de-immunized by using a next generation approach to humanization developed by Biovation, Ltd. (Aberdeen, UK) into a humanized form (huJ591).

Clinical experience with J591

Initial phase I studies using huJ591 trace-labeled with ^{111}In using a DOTA chelate showed that repetitive dosing was well tolerated with total doses of up to 500 mg/m² without the development of a human anti-humanized (de-immunized) antibody (HAA) response (41, 42). No dose limiting toxicity occurred and the maximum tolerated dose was not reached.

After the first dose, total body gamma camera images were obtained within one hour post-infusion (day 0) and on 3 more occasions in the following week. Excellent tumor targeting could be detected at all dose levels of mAb. No mAb targeting to non-prostate cancer sites was observed although, as seen in other trials using radiometals, the liver is the primary site of excretion. Per-cent injected dose in the liver diminished with increasing dose of antibody, and higher doses were associated with longer plasma clearance times (43-45).

Choice of Radionuclide

For targeted radionuclide therapy, monoclonal antibodies and peptides can be labeled efficiently with several radionuclides emitting beta particles (Table 1-1). The higher beta energy particles of ^{90}Y may be good for bulky tumors, but it may not be necessary or even sub-optimal, for small tumors and especially bone or bone marrow metastases. The relatively low energy beta particles of ^{131}I are ideal, but in vivo dehalogenation of radioiodinated molecules is a major disadvantage for internalizing antibody and peptide molecules. In contrast, ^{177}Lu has low energy beta particle with only 0.2-0.3 mm range and delivers much lower radiation dose to bone marrow compared to ^{90}Y . In addition, due to longer physical half-life (compared to ^{90}Y), the tumor residence times are higher. As a result, higher activities (more mCi amounts) of ^{177}Lu labeled agents can be administered with comparatively less radiation dose to marrow.

Table 1-1: Beta Emitting Radionuclides For Therapy

	¹³¹ I	⁹⁰ Y	¹⁷⁷ Lu
Physical half-life (days)	8.05	2.67	6.7
β ⁻ particles (MeV) Max	0.61	2.280	0.497
Average	0.20	0.935	0.149
Range in tissue (mm) Max	2.4	12.0	2.20
Average	0.4	2.7	0.25
Gamma emission (MeV)	0.364 (81%)	None	0.113 (7%) 0.208 (11%)
Equilibrium Dose Constant rad.g/hr. for β ⁻ radiation	0.389	1.9886	0.314
gamma	0.815	No	0.075

Phase I Trials of Radiolabeled J591.

Two independent phase I clinical trials have been performed at WCMC using ⁹⁰Y or ¹⁷⁷Lu linked via a DOTA chelate to huJ591 in patients with hormone-refractory prostate cancer (46, 47). Briefly, the primary objectives of these trials were to define the MTDs of the isotopes as well as to further define dosimetry, PK, and HAHA of the radiolabeled mAb conjugates. Anti-tumor responses were assessed as a secondary endpoint. The design and entry criteria of the 2 trials were identical. Eligible patients had a prior histologic diagnosis of prostate cancer and evidence of progressing recurrent or metastatic disease defined by at least 3 serially rising PSAs and/or radiographic studies. As prior studies had demonstrated that all prostate cancers were PSMA-positive (23), no determination of PSMA expression was done. Patients were required to have an absolute neutrophil count (ANC) $\geq 2.0 \times 10^9/L$, platelet count $\geq 150 \times 10^9/L$. Prior radiation therapy encompassing > 25% of the skeleton or prior treatment with ⁸⁹Strontium or ¹⁵³Samarium were not permitted. Other standard laboratory exclusion criteria applied as well (46, 47). Dose limiting toxicity in the 2 trials was defined as: Hematologic toxicity consisting of grade 4 thrombocytopenia (platelet $< 10 \times 10^9/L$) and/or grade 4 neutropenia (ANC $< 0.5 \times 10^9$) for greater than 5 days; and other toxicity consisting of grade ≥ 3 non-hematologic toxicity attributable to radiolabeled J591.

⁹⁰Y-J591 phase I trial:(46) Twenty nine subjects initially received 5 mCi of ¹¹¹In linked via a DOTA chelate to 20 mg of mAb J591 for pharmacokinetic and biodistribution determinations. One week later, they received ⁹⁰Y -DOTA-J591. All patients received 20 mg of mAb J591 with the ⁹⁰Y dose escalated in cohorts of 3 or more patients at the following planned dose levels: 5, 10, 15, and 20 mCi/m². A fifth dose level of 17.5 mCi/m² was added to more precisely define the MTD. Toxicity was dose-related and limited to reversible myelosuppression,

predominantly thrombocytopenia. The 17.5 mCi/m² dose level was determined to be the MTD. Four eligible patients were re-treated with none experiencing irreversible myelosuppression (no DLTs). J591 imaging of known sites of both bone and soft tissue metastases were seen in 90% of patients. Two patients at the 20 mCi/m² dose level (MTD + 1 level) experienced 85% and 70% declines in PSA lasting 8 and 8.6 months, respectively as well as objective measurable disease responses. An additional 6 patients (21%) experienced PSA stabilization. No HAHA response was detected.

¹⁷⁷Lu-J591 phase I trial:(47) In the ¹⁷⁷Lu trial, 35 subjects received a total of 10 mg/m² of J591 with escalating doses of ¹⁷⁷Lu ranging from 10 mCi/m²-75 mCi/m². Since ¹⁷⁷Lu can be directly imaged and has a longer physical t_{1/2} than ¹¹¹In, imaging took place during the 2 weeks following dosing. Patients received 10 mg/m² J591 with doses of ¹⁷⁷Lu ranging from 10 mCi/m²-75 mCi/m². Imaging demonstrated successful targeting of metastatic sites in 100% of the 30 patients with radiographic evidence of disease. The 70 mCi/m² dose was defined as the single-dose MTD with grade 4 thrombocytopenia as the DLT. Repeat dosing at 45 to 60 mCi/m² resulted in dose-limiting myelosuppression; up to 3 doses of 30 mCi/m² could be safely administered. PSA declines of ≥ 50% were seen in 4 patients lasting 3+ to 8 months. An additional 16 subjects (46%) experienced PSA stabilization for a median of 60 days (1 – 21+ months). No HAHA responses were detected.

Cytotoxin conjugated J591.

MLN2704 is a antibody-chemotherapy conjugate designed to target PSMA. J591 is conjugated to maytansinoid 1 (DM1), which is a potent microtubule-depolymerizing compound. Pre-clinical activity was demonstrated (48), leading to a phase I trial designed to explore single ascending doses of the conjugate to define DLT, MTD and PK (49). Twenty three subjects with progressive castrate metastatic prostate cancer received MLN2704 at doses ranging from 18 – 343 mg/m² in an accelerated dose escalation scheme; 18 received at least 3 doses. Grade ≥ 3 toxicities occurred in 2 subjects, including 1 episode of uncomplicated febrile neutropenia and transient grade 3 elevation of transaminases. One subject (treated at 343 mg/m²) achieved a >50% decline in PSA, and another (treated at 264 343 mg/m²) experienced a PR by RECIST along with a >50% decline in PSA.

A subsequent multicenter phase I/II study was initiated based upon the above results (50). Sixty two subjects received multiple doses of MLN2704. Because of neurotoxicity at every 1 or 2 week doses, the study was amended to include every 3 week dosing and dosing on days 1 and 15 of 42-day cycles. Of the 4 schedules tested, PSA declines were most frequent at 330 mg/m² every 2 weeks (2/6 had PSA decrease >50%, 2/6 had PSA stabilization). However, grade 2-3 neuropathy was dose-limiting, and could not be predicted by prior taxane-based chemotherapy, diabetes, or prior neuropathy. Although response was modest, and treatment was limited by toxicity, this trial demonstrated proof of principle that an immunoconjugate utilizing a PSMA antibody has therapeutic potential.

Phase II trial of ¹⁷⁷Lu-J591 in metastatic castrate resistant prostate cancer

Based upon the phase I results described above (47), a phase II trial has completed enrollment. In this investigator-initiated study, subjects with progressive metastatic CRPC received one dose of ¹⁷⁷Lu -J591 in two-cohorts. Cohort 1 (65mCi/m²), 15 pts; Cohort 2:

(70mCi/m²), 17 pts. The primary endpoint is PSA and/or measurable disease response; the secondary endpoint is toxicity. A ¹⁷⁷Lu-J591 imaging study was done to confirm tumor targeting. All of the initially planned 32 pts (14 chemo-naïve) have been treated. Preliminary analysis reveals the following (51):

Median age is 71 (range 51 – 88), median baseline PSA 77.92 (range 3.31 – 2184.6). Three pts achieved PSA declines of >50%. Another more preliminary analysis has been performed based upon retrospective analyses in patients on prospective chemotherapy trials demonstrating that 30% declines in PSA are most associated with survival benefits (52, 53). Of the 15 subjects receiving 65mCi/m², 2 of 15 (13%) achieved a 30% PSA decline. Of the 17 subjects receiving 70mCi/m², 7 (47%) experienced at least a 30% decrease in PSA.

Platelet nadir <25 x 10⁹/L occurred in 42% of pts, 9 of whom required 1 – 4 platelet transfusions (median = 2). 29/32 pts recovered normal platelet counts; the remaining 3 pts had rapidly progressive disease with bone marrow involvement. Neutropenia ≤ 0.5 x 10⁹/L occurred in 27% of pts, 6 of whom received brief therapy with growth factors. All 32 pts had normal neutrophil recovery and no pt experienced neutropenic fever. No significant drug-related non-hematologic toxicity has occurred. Excellent targeting of known sites of PC metastases has been observed in 31/32 (97%) of pts.

In summary, single dose ¹⁷⁷Lu-J591 demonstrates anti-tumor activity in pts with progressive CRPC with reversible myelosuppression. 32 of the initially planned 32 subjects have been treated to date and follow up is ongoing. Because of an FDA mandate, treatment was begun at a lower dose than the phase I MTD. Since there appears to be a dose response relationship (13 vs 47% with >30% PSA decline, 46 vs 71% with any PSA decline), an expansion protocol at the MTD is planned to tighten the confidence intervals for response at the MTD. Based upon acceptable toxicity in both groups and signals for increased efficacy at the higher dose (the MTD based upon the phase I trial), we are proceeding with the current trial.

2.2 Investigational Agent

2.2.1 J591

The J591 Mab is a deimmunized monoclonal antibody directed at the extracellular domain of human PSMA. J591 was derived from murine J591 using Biovation's (Biovation, Aberdeen, Scotland, UK) DeImmunisation technology in which individual amino acids in predicted B and T cell epitopes were replaced with other amino acids such that the epitope would no longer be recognized by the human immune system, thereby decreasing the likelihood of the development of an anti-mAb antibody response in humans.²⁸ This results in a potentially non-immunogenic antibody, which might be administered to patients on multiple occasions over long periods without inducing an immune response (see Clinical Experience). Furthermore, the deimmunized Mab additionally has been engineered to possess the effect of inducing antibody dependent cellular cytotoxicity (ADCC) with human immune effector cells.

J591 is produced from NS0 cells by Lonza (Lonza Biologics, Slough, UK). The molecular weight of J591 is approximately 147,000 daltons as determined by Matrix

Assisted Laser Desorption Mass Spectrometry (MALDI-TOF). The naked antibody is formulated in a 50 mM sodium phosphate, pH 5.5, containing 100 mM sodium chloride and 2 mM EDTA at a nominal concentration of 5 mg/mL.

2.2.2 DOTA-J591

In order to radiolabel J591 with β^- emitting radionuclides such as ^{177}Lu , the J591 antibody molecule is first conjugated to a macrocyclic chelating agent, 1,4,7,10-tetraazacyclododecane- N,N',N'',N'''-tetraacetic acid (DOTA) by direct coupling of one of the four carboxylic acid groups of DOTA to the primary amines present in the protein structure.

The DOTA conjugated antibody is formulated in 0.3 M ammonium acetate, pH 7.0 at a nominal concentration of 8 mg/mL.

2.2.3 Radiolabeled J591

The DOTA-J591 antibody molecule is labeled with radiometal ^{177}Lu or ^{111}In in 1.0 M ammonium acetate buffer at pH 7.0. The radiolabeled J591 complex is then purified using size-exclusion column chromatography.

To avoid the effects of autoradiolysis on the antibody, reaction time is minimized and the radiolabeled antibody preparations are formulated in phosphate buffered saline containing not more than 1% Human Serum Albumin (HSA). All reagents used in the conjugation and purification of J591 are made with pyrogen-free water. Radiolabeled J591 is periodically tested for sterility and pyrogenicity.

Each patient dose will be supplied to the study site on the day of or day before treatment by the central radiopharmacy.

The J591 mAb is a deimmunized monoclonal antibody directed at the extracellular domain of human PSMA. For additional details, see Section 1 and/or Investigator Brochure.

Radiolabeled antibody preparations are formulated in phosphate buffered saline containing not more than 1% Human Serum Albumin (HSA).

In order to radiolabel J591 with β^- emitting radionuclides, the antibody molecule is first conjugated to a macrocyclic chelating agent, 1,4,7,10-tetraazacyclododecane- N,N',N'',N'''-tetraacetic acid (DOTA) by direct coupling of one of the four carboxylic acid groups of DOTA to the primary amines present in the protein structure.

The radiolabeling of J591 with ^{177}Lu is achieved by adding the radionuclide to the ammonium acetate buffered J591. To avoid the effects of autoradiolysis on the antibody, reaction time is minimized and the reaction mixture is purified with a size exclusion column prior to administration.

All reagents used in the conjugation and purification of J591 are made from pyrogen-free water. Radiolabeled J591 is tested periodically for sterility and pyrogenicity. Refer to the Investigator Brochure for further details.

2.2.4 Pharmacokinetics

The pharmacokinetics of J591 antibody was studied in patients with prostate cancer using ^{111}In -J591 as a radiotracer. In a Phase 1 dose escalation study (see above) 4 groups of patients received different amounts of J591 antibody (25, 50, 100, 200 mg/m²) mixed with a trace amount of ^{111}In -J591 (5 mCi/1-2 mg). In a different Phase 1 dose-escalation study using ^{90}Y -J591 (see above), a group of patients received 20 mg of total J591 antibody mixed with a trace amount of ^{111}In -J591 (5 mCi/1-2 mg) for imaging studies prior to ^{90}Y treatment dose. These studies demonstrated that the plasma clearance kinetics of ^{111}In -J591 antibody is dose-dependent at low doses (<50 mg/m²). It should be noted that, in these studies, plasma clearance kinetics was determined based on the measurement of radioactivity in the plasma over time. The actual J591 antibody levels have not been measured; there is an assumption that the clearance of radiolabeled antibody does indeed reflect the J591 antibody clearance. The plasma clearance kinetics, based on bi-exponential fitting of plasma-time activity curves indicate that the terminal half-life ($T_{1/2\beta}$) is about 44.2±13.9 hrs at 11 mg/m² antibody dose and 59.3±16.6 hrs at 25 mg/m² antibody dose. At higher doses of antibody mass, the plasma clearance is relatively slower, but stable. In summary, the plasma clearance of antibody increases at lower doses of antibody (<25 mg/m²). In addition, repeat administration of J591 antibody over a 4-week period does not affect plasma clearance of radiolabeled J591 in patients with prostate cancer (data not shown).

In a Phase 1 dose-escalation study using ^{177}Lu -J591 (see above), a group of patients received J591 antibody mixed with a ^{177}Lu -J591 (10-70 mCi/m² and total J591 10mg/m²). The plasma clearance kinetics (shown in Table 1-2) demonstrate that there is no difference between ^{177}Lu and ^{111}In labeled J591 antibody.

Table 1-2: ^{177}Lu -J591 Vs. ^{111}In -hJ591: Plasma Clearance Kinetics

Pts.	mg/m²	$T_{1/2\alpha}$ (hr)	$T_{1/2\beta}$ (hr)	V_d at T_0	Clearance
n=18[#]	10	3.61±5.70	46.8±12	3949±1067	72±34
n=16[*]	11	2.37±1.94	44.2±14	4042±863	94±34
n=3^{\$}	25	3.36±2.17	59.3±17	3698±224	56±16
n=3^{\$}	50	7.83±9.5	99.7±32	4156±256	47±6.7
n=3^{\$}	100	5.7±7.5	105±38	4373±566	40±13

[#] = In a Phase 1 Dose escalation protocol, 18 patients were treated with ^{177}Lu -J591

^{*} = In a Phase 1 Dose escalation protocol, 16 Patients were treated with ^{90}Y -J591 and one week prior

to treatment, ^{111}In -J591 kinetics were studied.

^s = In a Phase 1 Dose escalation protocol with huJ591 cold antibody treatment, 3 patients in each group received different amounts of cold huJ591 mixed with ^{111}In -J591.

2.2.5 Biodistribution

The imaging studies with ^{111}In -J591 in patients with prostate cancer showed that liver is the principal organ with significant uptake of radiolabeled antibody. The liver uptake of J591 is a function of J591 antibody mass administered (Table 1-3): the higher the antibody mass, the lower the relative proportional uptake of radiolabeled antibody by the liver. In addition, at 20 mg of J591 administered in Phase 1 dose escalation trials with ^{111}In -DOTA-J591, the liver uptake increases with time and is at a maximum by day 6 (27.0 ± 1.7 % of injected dose). No significant localization was seen in other major organs, such as spleen and kidneys.

Biodistribution: ^{111}In -J591 vs. ^{177}Lu -J591

The imaging studies were done 5 times over a period of one week with ^{111}In and 2 weeks with ^{177}Lu . The uptake of radioactivity in various source organs (% injected dose/organ) was determined. The imaging studies clearly document that the in vivo distribution of radiolabeled J591 during the first week is quite similar with both ^{111}In and ^{177}Lu radionuclides (Table 1-4).

Table 1-3: ^{111}In -J591: Liver Uptake (% injected dose) as a Function of J591 Antibody Mass

<u>Time</u>	<u>11 mg/m²</u>	<u>25 mg/m²</u>	<u>50 mg/m²</u>
1	13.1 \pm 2.5	9.6 \pm 1.0	7.9 \pm 0.8
24	19.0 \pm 3.2	12.9 \pm 2.1	11.2 \pm 1.2
48	20.8 \pm 2.8	ND	11.0 \pm 0.4
72	22.5 \pm 2.4	14.5 \pm 1.2	12.1 \pm 1.0
120	24.6 \pm 2.8	ND	ND
144	27.0 \pm 1.7	17.1 \pm 3.2	13.9 \pm 1.0

Table 1-4: Biodistribution of Radiolabeled J591 Antibody

¹¹¹ In-J591				¹⁷⁷ Lu-J591					
Organ	DAY 0		DAY 6			DAY 0		DAY 7	
Whole Body	100.0	± 0.0	66.1	± 18.4		100.0	± 0.0	69.8	± 9.5
Remainder	52.3	± 5.7	24.9	± 16.8		57.5	± 6.4	34.7	± 6.9
Heart Contents	8.9	± 2.3	3.4	± 1.2		8.8	± 2.2	3.1	± 0.9
Kidneys	2.4	± 0.8	2.5	± 0.7		2.2	± 0.5	2.5	± 0.5
Liver	14.7	± 3.2	28.0	± 7.8		15.0	± 3.8	23.7	± 7.0
Lungs	9.0	± 2.0	4.4	± 1.7		6.9	± 1.9	3.1	± 0.7
Red Marrow	10.9	± 5.0	1.2	± 1.1		7.4	± 2.4	0.6	± 0.4
Spleen	1.8	± 0.6	1.7	± 0.8		2.2	± 1.0	2.1	± 0.8

2.2.6 Radiation Dosimetry

Based on imaging studies and plasma clearance with ¹⁷⁷Lu-J591, the residence times (τ) of radioactivity in various source organs (as shown in Table 1-4) were calculated. Using “S” factors from MIRD tables, radiation dosimetry (cGy/mCi) for ¹⁷⁷Lu-J591 was estimated (Table 1-5). Following administration of ¹⁷⁷Lu-J591, the liver is the critical organ, receiving 7.77 ± 2.23 rads/mCi, and the kidneys and spleen receive <7 rads/mCi. The bone marrow dose was estimated to be 1.17 ± 0.37 rads/mCi based on the assumption that 36% of bone marrow volume represents plasma volume.

Hematopoietic toxicity is usually the dose-limiting factor in RIT (54). Radiation dose of 9.0 Gy to the bone marrow is generally regarded as an “organ injury dose” and the tolerable absorbed doses were usually estimated to be 65% of LD50 (50%) organ injury dose. Therefore, the tolerable absorbed dose for bone marrow is about 3.0 Gy (330 rads). The maximum tolerable radiation doses to kidneys, liver and spleen are approximately 20-25 Gy (2000-2500 rads). Dosimetric studies using radiolabeled antibodies have been effectively used by many investigators to determine patient-specific radiation dosimetry of radiolabeled antibody treatment (55, 56). Based on the dosimetry data shown in Table 1-5, the maximum bone marrow dose following administration of 70mCi/m² of ¹⁷⁷Lu-J591 would deliver 164 rads to an average person with a BSA of 2.0 m². The maximum dose the liver would be about 1100 rads, well below the maximum tolerable liver dose.

Table 1-5: Radiation Dosimetry (rads/mCi) of ^{177}Lu -J591 in Patients with Prostate Cancer

Organ	Mean		S.D.
Adrenals	0.52	±	0.08
Brain	0.40	±	0.07
Gall Bladder	0.55	±	0.08
LLI Wall	0.42	±	0.07
Small Intestine	0.43	±	0.07
Stomach	0.45	±	0.07
ULI Wall	0.44	±	0.07
Heart Wall	3.50	±	0.70
Kidneys	5.20	±	1.29
Liver	7.77	±	2.23
Lungs	2.79	±	0.80
Muscle	0.42	±	0.07
Pancreas	0.52	±	0.08
Red Marrow	1.17	±	0.37
Bone Surfaces	0.70	±	0.14
Skin	0.42	±	0.07
Spleen	7.28	±	3.41
Testes	0.36	±	0.13
Thymus	0.44	±	0.07
Thyroid	0.41	±	0.07
Urin. Bladder Wall	0.97	±	0.22
Total Body	0.71	±	0.10
Effective Dose Equiv.	2.14	±	0.35
Effective Dose	1.33	±	0.19

2.3 Rationale

As stated above, we have validated that J591 can target known sites of disease and have preliminary evidence that there is anti-tumor effect of radiolabeled J591. Since forms of radiotherapy have been validated in the clinically localized as well as salvage setting, “targeted radiotherapy” in the form of radioimmunotherapy is at least theoretically an attractive option with the possibility being a higher yield therapy in the minimal disease (biochemical only) setting [see information on anti-CD20 based radioimmunotherapy above].

The objective of this study is to determine the efficacy of the addition of ^{177}Lu -J591 to ketoconazole in men with progressive biochemical (PSA) prostate cancer despite medical or surgical castration. All subjects will receive ketoconazole (400 mg p.o. TID) plus replacement doses of hydrocortisone (20 mg am, 10 mg pm). Subjects will be randomized to receive a single dose of 70 mCi/m² ^{177}Lu -J591 or trace-labeled ^{111}In -J591 (i.e. placebo). Subjects will be followed for response, disease progression, safety and toxicity. The treatment phase will last until progression of disease or toxicity necessitating discontinuation of therapy. Subjects will be followed until the primary endpoint, which is the development of radiographically apparent metastatic disease.

2.4 Correlative Studies Background

2.4.1 Adrenal androgen levels

Although androgen deprivation therapy with LHRH agonists are successful in suppressing testosterone levels in the majority of cases, adrenal androgen levels are not typically suppressed by significant amounts (57). In addition, some evidence exists that targeting adrenal androgens may play a role in the management of prostate cancer (58, 59), leading to the common use of ketoconazole for this purpose. CALGB 9583 was a randomized trial of antiandrogen withdrawal with or without ketoconazole (60). As part of the correlative sciences portion of this trial (secondary endpoint), adrenal androgen level were prospectively collected. Baseline adrenal androgen levels in men with metastatic castrate resistant prostate cancer were associated with PSA response and overall survival (61). Based upon these data, we plan to prospective assess and validate these results in men with biochemically progressive castrate resistant prostate cancer. As published we will compare the median baseline androgen levels in those with a PSA response vs those without. In addition, we will categorically analyze subsets of baseline adrenal androgen levels and correlate them with time to development of radiographically apparent metastatic disease and overall survival. As the published analysis did not prospectively identify categorical values for analysis (median levels were used), we will also use prospective determined levels based upon the published studies and categorize subsets for analysis.

2.4.2 Plasma markers of hemostatic activation, fibrinolysis, and angiogenesis

Trousseau first published the link between malignancy and thrombosis in 1865 (62). Since then, various physicians and scientists have studied this association in terms of thrombotic mechanisms, determinants of cancer prognosis, and treatment outcomes. Data from the MEGA study, a large population-based, case-control study, revealed that cancer increases the risk of venous thromboembolism 7-fold overall, with a higher risk near the time of diagnosis and with advanced rather than localized disease (63). The presence of a malignancy also increases the risk for recurrent venous thromboembolism (64, 65). In addition, both the Levitan study (64) and data from the Danish registries (66) found that thrombosis in the cancer patient predicts for worse prognosis and a shorter survival.

Even in the absence of clinical thromboembolic disease, abnormalities in coagulation tests in patients with malignancy are common. Elevation of coagulation factor levels, fibrin degradation products, and platelet counts are common (67). Other more specific parameters demonstrative of activation of hemostasis, including thrombin-antithrombin (TAT) complexes, fibrinopeptide A, D-dimers and prothrombin fragment F1+2, are also elevated. The hemostatic activation observed in many cancer patients may be the result of direct activation by the malignant cell or an indirect effect mediated through activated endothelium or monocytes (68, 69).

The link between early activation of hemostasis and cancer prognosis has also been demonstrated in clinical studies. D-dimers are a marker of fibrin formation and degradation by both thrombin and plasmin. The levels of D-dimers are elevated in a variety of clinical situations associated with increased thrombin generation such as disseminated intravascular coagulation and thromboembolic events. Clinical studies have shown that D-dimer levels are significantly elevated in many patients with both disseminated and limited malignancies without evidence of clinical thromboembolism (67). Quantitative measurements of D-dimers, using sensitive immunoassays, have been reported to have prognostic significance. The plasma level of D-dimers predicts survival in patients with both limited and disseminated lung cancer (70-72). Similarly, in women with breast cancer, levels of D-dimers have correlated with malignant versus benign breast lesions (73), the presence of lymph node metastases on surgical pathology (73), and with volume of disease, time to progression, and overall survival in metastatic disease (74). Quantitative D-dimer levels also correlate with levels of IL-6 and VEGF (74). In patients with colorectal cancer, pre-operative levels of D-dimer have been correlated with stage of disease, tumor size and or depth of invasion, lymph node metastases, and distant metastases (75). Levels of D-dimers have also correlated with FIGO stage in women with ovarian cancer (76). Pre-operative levels of plasma TAT complexes, an assay more reflective of immediate thrombin generation, have been correlated with risk of venous thrombosis in patients with cancer undergoing surgery (77). Plasma TAT levels have also been shown to correlate with response to therapy and prognosis in patients treated for lung cancer (78). In addition, there is evidence that inhibitors of coagulation may decrease tumor growth, limit metastases, and improve survival in cancer models (79-82).

Like many other cancers (as discussed above), prostate cancer is linked to thrombosis. In a review of patients with thrombosis with or without cancer using Medicare claims data, prostate cancer was the third most common type of malignancy to be associated with a thrombosis (64). Activation of both the coagulation and fibrinolytic systems has been demonstrated in prostate cancer (83). Clinically, men with carcinoma of the prostate are at increased risk of thromboembolic disease, but may also have increased risk of bleeding (84). The interaction of tumor cells with the coagulation and fibrinolytic systems is likely to be important in tumor growth and spread. Markers of activation of coagulation, including D-dimers, TAT, and prothrombin fragment F1+2, are elevated in men with advanced prostate cancer compared to age-matched controls (85). TF expression (using immunohistochemistry) has also been correlated with angiogenesis and PSA level (86). In metastatic disease, immunohistochemical assessment of biopsy specimens for TF correlated with prognosis with androgen deprivation therapy (87). Preoperative levels of IL-6 and its receptor are associated with recurrence and progression in localized prostate cancer (88, 89). Increased VEGF expression correlates with Gleason score and pathologic stage in localized prostate cancer (90). However, in prostate cancer as in other cancers, it is unclear if expression of angiogenic markers in tumor tissue or neighboring normal tissue or stroma is more important prognostically (91-93).

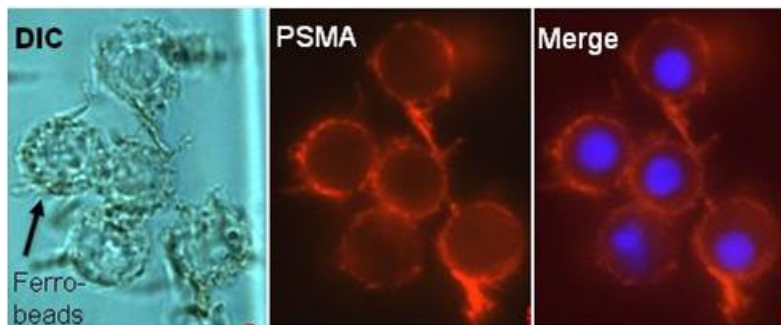
On our own preliminary data set, we have shown that subclinical hemostatic activation is common in men with untreated clinically localized prostate cancer and correlates with objective measures of surgical blood loss with prostatectomy (94). We have confirmed others' observations that trends of several markers increase with age (fibrinogen, $p=0.005$; TAT, $p=0.088$; D-dimer, $p<0.001$; IL-6, $p<0.001$; IL-8, $p=0.059$) (95). We also noted trends for correlations amongst several markers (TAT and D-dimer, $p<0.001$; TAT and IL-6, $p=0.009$; D-dimer and IL-6, $p<0.001$, fibrinogen and D-dimer, $p<0.001$; fibrinogen and IL-6, $p<0.001$; fibrinogen and IL-8, $p=0.076$) (95). In addition, we found a correlation between pre-operative IL-6 levels and pre-operative PSA and a validated post-operative prognostic nomogram-derived score ($p=0.038$) which predicts prostate cancer recurrence at 10 years after radical prostatectomy using pre- and post-operative variables (96)(95). Preliminary data from a pilot study in men with advanced, untreated prostate cancer examining the effect of androgen deprivation on markers of hemostatic activation, fibrinolysis, and angiogenesis, data from the first 3 subjects reveals that levels of markers decrease significantly after only one month of therapy (mean decreases in TAT by 60.9%, IL-8 by 24.9%, IL-6 by 60.5%, and D-dimers by 72.1%). In addition, the reverse has been observed anecdotally in one pt with markers drawn pre-operatively and again upon recurrence (increase in TAT by 316%, IL-8 by 259%, IL-6 by 307%, and D-dimer by 2226%). Our hypothesis is that further hormonal therapy with ketoconazole will affect these markers as well. We will assess baseline values and compare values at 1 month and 6 months after therapy. In addition to assessing changes with therapy, we will perform exploratory analyses examining the use of baseline values as well as percent change in predicting response to ketoconazole.

2.4.3 Circulating tumor cells (CTCs)

Assays to detect CTCs in the peripheral blood of cancer patients have been used clinically to provide prognostic information and to test for minimal residual disease. Typical methods to detect these CTCs are either antibody-based (immunocytochemistry or flow cytometry) or RT-PCR; each has its specific advantages and limitations. For example, RT-PCR can be very sensitive and highly specific when the expression of the target mRNA is limited to malignant tumor cells. Flow cytometry, on the other hand, has been used to detect and authenticate cells as CTCs, but it does not allow visual confirmation of cell morphology or discrimination of changes at the subcellular level (97). The challenges in CTC detection relate to the need for high sensitivity combined with high specificity. Important progress in this field has recently arisen with the development of a semi automated enrichment system, the CellSearch (Veridex LLC, Warren, NJ) that uses an antibody-based immunomagnetic-capture and automated staining methodology (98). The immunomagnetic capture is achieved with the use of a ferrofluid-coated antibody specific for the epithelial cell adhesion molecule EpCAM (99), a 40 KD, transmembrane glycoprotein that consists of two epidermal growth factor-like extracellular domains. EpCAM, encoded by the *GA733-2* gene located on the long arm of chromosome 4 (100), has been described under various names, mostly associated with monoclonal antibodies specific for cell surface antigen (MH99, AUA1, MOC31, 323/A3, KS1/4, GA733, and HEA125 (used in this assay). Litvinov *et al.* first suggested the name EpCAM, which more precisely reflects the molecule's function and tissue specificity. EpCAM is detected at the basolateral membrane of the majority of epithelial tissues, and is overexpressed by the majority of human epithelial carcinomas, including colorectal, breast, prostate, and head and neck carcinomas (101). Thus, use of antibodies to EpCAM allows for circulating epithelial-derived tumor cells to be isolated and concentrated from peripheral blood so they can be further inspected by microscopy. However, as EpCAM, can also be expressed in leucocytes, the specificity of this antibody-based assay to detect CTCs is lowered to 80%. To increase the specificity of detection for epithelial tumor-derived cells, CellSearch technology uses three additional immunostains: an antibody against CD45 conjugated with allophycocyanin to identify white blood cells (WBC), the nuclear dye [4,6-diamidino-2-phenylindole (DAPI)] to fluorescently label the cells' nuclei, and two phycoerythrin-conjugated anti-cytokeratin antibodies recognizing cytokeratins (predominantly cytokeratins 8, 18, and 19) to more specifically identify epithelial cells as such. Stained cells are analyzed on a fluorescence microscope using the Cell Track Analyzer II. Automatically selected images are then reviewed by the operator for the identification and counting of CTCs. The criteria for an object to be defined as a CTC include: round-to oval morphology, a visible nucleus (DAPI staining), positive staining for cytokeratins, and being negative for CD45. In addition, the consensus pathognomonic features of epithelial tumor cells, such as a clearly enlarged nucleus, high nucleus/cytoplasmic ratio and/or clusters of two or more immunopositive cells are also part of the CTC definition criteria, further attesting to the epithelial-tumor specificity developed in the CellSearch method (for review see (102)). The accuracy, sensitivity and linearity of CTC detection by this method has been previously established (98).

Clinical studies of CTCs in humans with cancer: Using this system, Cristofanilli et al. show in a prospective study, that CTC detection provides significant prognostic information for patients with metastatic breast cancer (103). In this pivotal study, the detection of >5 CTCs per 7.5 mL of blood at the start of chemotherapy and after each cycle of therapy was associated with shorter progression-free and overall survival for patients with metastatic breast cancer. Another related study in metastatic breast cancer revealed that CTC counts are more predictive of outcomes than the standard clinical parameters (104). The CellSearch system and reagents have now been Food and Drug Administration–cleared for routine clinical use in metastatic breast, colorectal, and prostate cancer. Recent studies using this technology in prostate cancer also show that a count of >5 CTCs per 7.5 mL of blood is associated with poor overall survival, in this case in patients with metastatic PC (105, 106). Furthermore, in a subset of CRPC patients, the presence of CTCs was shown to be the most significant parameter predictive of survival in both univariate and multivariate analyses (105). These single institution findings have been confirmed with a multi-centered study (Moreno et al., American Society of Clinical Oncology 2007 Annual Meeting), leading to an application for FDA approval in prostate cancer. Finally, it has been demonstrated that CTC's isolated using this technology can be analyzed with immunohistochemistry, immunofluorescence, and FISH analysis, which has confirmed the neoplastic nature of these cells and demonstrated amplification of the androgen receptor (107). For these reasons, we believe this technology is the most advanced, sensitive, and appropriate for our CTC study. We will perform cell counting on 7.5 mL samples at baseline, 1 month (pre-J591 for that arm), 2 months, and at 6 months. We will analyze baseline levels (< 5 CTCs/7.5 mL blood vs ≥ 5) as well as changes with treatment for associations with PSA response and time to development of radiographically evident metastatic disease.

WCMC studies using CTCs in prostate cancer: We have been using the CellSearch system to count CTCs. However, using this methodology the enumerated CTCs cannot be retrieved for any further molecular analysis. Thus, we have collected an additional sample of blood which is subjected to automated immunomagnetic selection using the CellSearch profile kit allowing us to selectively collect the EpCAM-positive cells without any additional staining. Following isolation, isolated tumor cells may be assessed using a variety of methods. Since PSMA expression is universal, there has not been any selection of patients treated on any of our clinical trials utilizing J591. We will explore the utility of assessment of PSMA expression by immunohistochemistry (scored in quantitative fashion) of pre-treatment CTCs with relationship to response to Lu-J591.



PSMA staining in CTCs isolated from the blood of a CRPC patient. The EpCAM-enriched cells were isolated from the blood of CRPC patients and were further immunostained for PSMA (J591) and DAPI. **Left Panel:** Phase image of the ferrobead captured cells, showing the ferrobead location and the overall cell integrity. **Middle Panel:** PSMA immunostaining shows a distinct cell-membrane localization. **Right Panel:** Merged image of PSMA and DAPI staining. The diameter of the depicted cells is approximately 15 μm .

2.4.4 Patient Reported Outcomes

Quality of life has not been well-described in men with non-radiographically evident CRPC. In addition, while the appearance of radiographically-evident metastatic disease is generally agreed to be a negative prognostic event, studies assessing the initial appearance of metastases have only sub-optimally examined patient symptoms.

The Functional Assessment of Cancer Therapy – Prostate (FACT-P) questionnaire is a validated tool to assess both global and prostate cancer specific symptoms and quality of life. The FACT-P (version 4) questionnaire will be completed by subjects at baseline and at each radiographic assessment timepoint (prior to results).

3. PATIENT SELECTION

3.1 Inclusion Criteria

3.1.1 Patients must have histologically or cytologically confirmed adenocarcinoma of the prostate.

3.1.2 Biochemical progression (rising PSA) after medical or surgical castration

- Subjects who have received antiandrogens (such as bicalutamide) and have experienced PSA decline must have biochemically (PSA) progressed following discontinuation of anti-androgen therapy.
- **PSA:** An increase in PSA determined by two separate measurements taken at least one week apart and confirmed by a third, and if necessary, a fourth measurement. If the third measurement is not greater than the second measurement, then a fourth measurement must be taken; the fourth measurement must be greater than the second measurement for the patient to be eligible for enrollment in the study. Furthermore, the confirmatory PSA measurement (i.e., the third or, if applicable, fourth PSA measurement) must be ≥ 1 ng/mL with prior prostatectomy or ≥ 2 ng/mL without prostatectomy and $\geq 25\%$ above the previous nadir.

3.1.3 High risk of systemic progression defined as:

- Rising PSA as defined above and either:
 - Absolute PSA > 20 ng/mL
 - AND/OR
 - PSA DT < 8 months
- PSA doubling time (PSA-DT) will be calculated using a linear regression model. In the model, the logarithm of PSA will be modeled as a linear function of time. The PSA-DT will be calculated as the product of log 2 multiplied by the reciprocal of the slope of the regression equation, for which the logarithm is the natural log function. For standardization purposes across sites, a web-based PSA doubling time calculator developed by Memorial Sloan Kettering, is available at

<http://www.mskcc.org/mskcc/html/10088.cfm>

The minimum PSA value for eligibility will be greater than or equal to 1 with prior prostatectomy or at least 2 ng/mL without prostatectomy. All PSA values of at least 0.1 ng/mL over the past 6 months must go into the equation. A minimum of 3 PSA values with a minimum of 2 weeks between assessments is required (the screening PSA may be used for the 3rd value if necessary).

- 3.1.4 No evidence of local recurrence or distant metastases within 1 month of enrollment (or following enrollment as part of screening) including:
- Radionuclide bone scan without evidence of metastatic disease
 - In the event of an equivocal bone scan, confirmation is needed with Xray, CT scan, or MRI
 - CT or MRI of abdomen/pelvis without evidence of metastatic disease or recurrent disease in the prostate or prostate bed
 - If no prior prostatectomy or radiation to the prostate, multiparametric MRI (mpMRI) of the prostate must have been performed and scored with PIRADS v2. The PIRADS score must be <3. (Appendix H: Summary of PIRADS V2 Scoring). mpMRI must be performed within 30 days prior to randomization.
 - Chest Xray or CT of chest without evidence of metastatic disease
 - Digital rectal exam (DRE) without clinical suspicion of recurrent/persistent prostate cancer
- 3.1.5 Age ≥ 18 years.
- 3.1.6 Serum testosterone ≤ 50 ng/ml
- 3.1.7 The effects of J591 on the developing human fetus at the recommended therapeutic dose are unknown. For this reason, patients capable of fathering children must agree to use an effective method of contraception for the duration of the trial.
- 3.1.8 Subjects on bisphosphonate therapy or denosumab must be on a stable dose and must have started therapy ≥ 4 weeks prior to protocol therapy. Initiation of bisphosphonate therapy or denosumab is not allowed during the treatment phase.
- 3.1.9 Ability to understand and the willingness to sign a written informed consent document.

3.2 Exclusion Criteria

- 3.2.1 Use of red blood cell or platelet transfusions within 4 weeks of treatment
- 3.2.2 Use of hematopoietic growth factors within 4 weeks of treatment
- 3.2.3 Prior cytotoxic chemotherapy and/or radiation therapy within 4 weeks of treatment
- 3.2.4 Prior radiation therapy encompassing >25% of skeleton (see Appendix C)
- 3.2.5 Prior treatment with ⁸⁹Strontium or ¹⁵³Samarium containing compounds (e.g. Metastron®, Quadramet®)
- 3.2.6 Platelet count <150,000/mm³ or known primary qualitative platelet disorder
- 3.2.7 Absolute neutrophil count (ANC) <2,000/mm³
- 3.2.8 Hematocrit <30 percent and Hemoglobin < 10 g/dL
- 3.2.9 Abnormal coagulation profile (PT or INR, PTT > 1.3x ULN) unless on therapeutic anticoagulation – see concomitant meds section
- 3.2.10 Serum creatinine >2.5 mg/dL
- 3.2.11 AST (SGOT) >2x ULN
- 3.2.12 Bilirubin (total) >1.5x ULN; subjects with Gilbert's syndrome will be allowed if direct bilirubin is within institutional normal limits
- 3.2.13 Active serious infection
- 3.2.14 Active angina pectoris or NY Heart Association Class III-IV
- 3.2.15 ECOG Performance Status > 2
- 3.2.16 Life expectancy <12 months
- 3.2.17 History of deep vein thrombosis and/or pulmonary embolus within 1 month of study entry
- 3.2.18 Other serious illness(es) involving the cardiac, respiratory, CNS, renal, hepatic or hematological organ systems which might preclude completion of this study or interfere with determination of causality of any adverse effects experienced in this study

- 3.2.19 Prior investigational therapy (medications or devices) within 4 weeks of treatment. Furthermore, other investigational therapy is not permitted during the treatment phase.
- 3.2.20 Prior use of ketoconazole for the purposes of prostate cancer therapy for greater than 1 month
- 3.2.21 Known history of HIV.
The effects of J591 are unknown in this population. Furthermore, ketoconazole has many well-described drug-drug interactions which could affect antiviral therapy. If necessary, this population will be studied separately.
- 3.2.22 Currently active other malignancy other than non-melanoma skin cancer.
Patients are considered not to have “currently active” malignancy if they have completed any necessary therapy and are considered by their physician to be at less than 30% risk of relapse.
- Known history of known myelodysplastic syndrome
- 3.2.23 Adrenal hormone inhibitors (other than ketoconazole) within 4 weeks prior to study enrollment.
- 3.2.24 Finasteride (Propecia® or Proscar®) or dutasteride (Avodart®) within 4 weeks of enrollment.
- 3.2.25 Patients on corticosteroids prior to enrollment must have either discontinued and shown biochemical progression or have biochemical progression on a stable dose

4. ENROLLMENT AND REGISTRATION PROCEDURES

4.1 Enrollment Procedures

4.1.1 Identification of subjects

Potential subjects will be recruited from the oncology, urology, and radiation oncology practices of participating institutions and affiliates. Public advertisements will be allowed if approved by WCMC and the local IRB. Pre-screening of potential subjects may be performed by investigators or delegates under their direct supervision. Investigational sites may elect to obtain waiver of HIPAA for pre-screening purposes.

4.1.2 Consent process

Potential subjects will have a discussion with the investigator/delegate including the rationale for the study, investigational nature of the protocol and study drug and the voluntary nature of participation, potential risks and benefits, alternatives to participation, and study procedures. Individuals will have the opportunity to read the written informed consent document at their leisure (preferably outside of the clinical

area for > 1 day) and the opportunity to have questions answered in a private location with the understanding that should they decide not to participate, they will still be able to receive any available therapy off-trial. Potential subjects will also have the opportunity to obtain the advice of their treating physician. Investigators or delegates under their direct supervision will verify the subject's understanding of the investigational and voluntary nature of the study, the potential risks and benefits, study procedures, and alternatives prior to signing of the written informed consent.

Documentation of the consent process and that written consent was conducted must be documented in the subject's medical record.

4.2 Central Patient Registration

Patients will be centrally registered with the Weill Cornell Medical College (WCMC), Division of Hematology and Medical Oncology Clinical Research Office. To register a patient, upload the following documents into a pdf file(s) and email to guonc@med.cornell.edu (note that this email address will not accept emails larger than 4.5 MB in size, so large size files may need to be split). If scan/email is not readily available, fax to the Clinical Research Office at 646-962-1611. Fax should be followed by phone call or email to ensure receipt.

- WCMC Patient Enrollment Form
- First and last page of the fully executed informed consent form, plus additional pages if checkboxes for correlative studies are required.
- Fully executed HIPAA research authorization form (if separate from the consent document)
- Eligibility checklist signed and dated by investigator and research nurse
- Source documents verifying eligibility including
 - i. Pathology report confirming diagnosis
 - ii. Laboratory reports confirming PSA progression
 - iii. Radiology reports, bone scan, CT/MRI scan of abdomen/pelvis and Chest x-ray or CT scan
 - iv. Laboratory reports confirming all required eligibility criteria have been met
 - v. On-study visit note documenting PS and consenting process
- Documentation of any eligibility waivers granted

Central registration information is reviewed and entered into the HemOnc centralized research database. These documents should be emailed (or faxed if email is not feasible) Monday to Friday from 9:00 AM to 4:45 PM EST. Patients will be assigned a sequence number for the protocol. The registering institution will then be faxed a copy of the sequence number as confirmation of a completed registration.

Registration of patients cannot occur until the Coordinating Center has received proper documentation from the registering institution of IRB approval, including a copy of the current approval letter, stamped consent and signed FDA-1572 form. These documents may be emailed to guonc@med.cornell.edu or faxed to the Coordinating Center at 646-962-1611.

5. TREATMENT PLAN

5.1 Agent Administration

Treatment will be administered on an outpatient basis. Reported adverse events and potential risks are described in Section 7. Appropriate dose modifications for ketoconazole and hydrocortisone are described in Section 6. No investigational or commercial agents or therapies other than those described below may be administered with the intent to treat the patient's malignancy.

5.1.1 Ketoconazole (all subjects)

Ketoconazole (Nizoral) will be prescribed at a dose of 400 mg (two 200 mg tabs) to be taken orally (preferably on an empty stomach) three times per day (total daily dose of 1200 mg). For subjects on chronic gastric acid suppressive therapy (chronic administration of proton pump inhibitors or H₂ blockers), ketoconazole should be taken with cola or orange juice. The cost of the drug will be billed to the subject's insurance company.

5.1.2 Hydrocortisone (all subjects)

Hydrocortisone (Cortef) will be prescribed at a dose of 20 mg orally each morning, 10 mg orally each evening (total daily dose of 30 mg). The cost of the drug will be billed to the subject's insurance company.

5.1.3 Radiolabeled J591

Eligible patients will receive a single dose of ¹⁷⁷Lu-J591 (70 mCi/m²) or ¹¹¹In-J591 (5 mCi) on a Thursday or Friday approximately 4 weeks after cycle 1, day 1 consisting of J591 chelated at a specific activity of 12-15 mCi of ¹⁷⁷Lu per mg of antibody plus sufficient non-radiolabeled, non-DOTA-conjugated ("naked") J591 to achieve a total antibody dose of 20 mg. Each dose will be administered by an IV infusion at a rate not to exceed 5 mg/min.

5.1.3.1 Radiolabeled-J591 pre-medications

It is suggested that subjects receive pre-medications prior to J591 infusion with diphenhydramine 25 – 50 mg p.o. or IV and acetaminophen 325 – 650 mg p.o.

5.1.3.2 Monitoring post- radiolabeled-J591 infusion

During and after infusion, patients will be monitored for possible allergic reaction. Allergic events will be managed as follows: rash, pruritis, urticaria and wheezing will be treated with diphenhydramine hydrochloride, meperidine and/or steroids as clinically appropriate. Anaphylaxis or anaphylactoid signs or symptoms will be treated with steroids and/or epinephrine as clinically indicated. Patients will be treated in a facility that is equipped for cardiopulmonary resuscitation. Infusion-related reactions (fever, rigors) will be treated with acetaminophen, meperidine and diphenhydramine hydrochloride as clinically appropriate.

5.1.3.3 Vital signs pre/post radiolabeled J591 infusion

Vital signs (temperature, heart rate, blood pressure, respiratory rate) should be documented 0-30 min prior to infusion. 12-18 minutes following infusion of study drug, temperature, heart rate and blood pressure should be documented. Heart rate, blood pressure, and respiratory rate should then be documented at least every 15 minutes x3, then every 30 minutes x2. In addition to baseline and at 15 min, temperature should be documented at least hourly x2 following infusion of study drug. Subjects experiencing Gr > 0 infusion reactions at 2 hours post-infusion should be monitored for an additional hour. Additional vital signs may be performed at the discretion of the study team. Detailed instructions for vital signs are as follows:

Pre-infusion (0-30 min before infusion): temperature, HR, BP, RR

[Infusion will last a minimum of 4 minutes]

Post infusion #1 (15 min +/-3 following end of infusion): temperature, HR, BP, RR

Post infusion #2 (30 min +/-3 following end of infusion): HR, BP, RR

Post infusion #3 (45 min +/-3 following end of infusion): HR, BP, RR

Post infusion #4 (60 min +/-5 following end of infusion): temperature, HR, BP, RR

Post infusion #5 (90 min +/-5 following end of infusion): HR, BP, RR

Post infusion #6 (120 min +/-10 following end of infusion): temperature, HR, BP, RR

5.1.4 Castration

All subjects who have not been surgically castrated will continue to receive LHRH agonist/antagonists to maintain chemically castrated state (goal testosterone < 50) as part of standard care. Examples of acceptable medications include leuprolide and goserelin.

5.2 General Concomitant Medication and Supportive Care Guidelines

All medications that are administered during the study must be recorded in the patient's CRF and in the source documents. Concomitant medications for other medical conditions are permitted as clinically indicated subject to specific protocol requirements outlined below.

5.2.1 Excluded medications

- Aspirin and/or non-steroidal anti-inflammatory agents possessing anti-platelet activity must be discontinued if the platelet count drops below 150,000. These medicines may be re-initiated at the discretion of the treating physician after confirmed recovery from any thrombocytopenia (after 2 consecutive rises with 2nd \geq 100,000).
- Anti-platelet medications including, but not limited to, abciximab, cilostazol, clopidogrel, dipyridamole and ticlopidine HCL should be discontinued if the platelet count drops below 150,000. These medicines may be re-initiated at the discretion of the treating physician after confirmed recovery from any thrombocytopenia (after 2 consecutive rises with 2nd \geq 100,000).

- Anti-coagulant medications including, but not limited to, heparins (unfractionated and low molecular weight forms), coumarins (including warfarin sodium), anti-Xa inhibitors (including fondaparinux and abixaban), and direct thrombin inhibitors (including rivaroxaban) at therapeutic doses when platelet count $<50,000/\text{mm}^3$. These medications may be re-initiated upon confirmed recovery of thrombocytopenia (after 2 consecutive rises with the 2nd above 75,000)
- Any investigational mAb based therapy not covered in this protocol. Note that “approved” monoclonal antibody therapy such as denosumab is allowed provided that subjects have initiated therapy and are on a stable dose/schedule at least 1 month prior to enrollment.
- Medication to support platelet count (such as oprelvekin (Neumega®), romiplostim (Nplate), eltrombopag (Promacta)).
- Patients on drugs known to be metabolized by the cytochrome P450 system (specifically CYP 3A4) should be cautioned about potential interactions with ketoconazole. Specifically, cisapride, terfenadine and astemizole are contraindicated (see black box warning in product’s label). Any such interactions should be discussed with the patient’s treating physician.

5.2.2 Myelosuppression guidelines

5.2.2.1 Thrombocytopenia – monitoring guidelines

- Based upon previous studies, the expected time of platelet nadir is expected to be 4-5 weeks after Lu-J591 infusion. Physicians should search for additional causes of thrombocytopenia when suspected, especially if the platelet count falls < 3 weeks before or > 8 weeks after Lu-J591 infusion.
- During periods of time when the platelet count is $< 25,000/\text{mm}^3$, platelet counts must be monitored at least twice per week.

5.2.2.2 Thrombocytopenia – transfusion guidelines

- Per ASCO guidelines (108), prophylactic platelet transfusion is recommended at a threshold platelet count of $10,000/\text{mm}^3$.
- Physicians should use their clinical judgment in determining the need for platelet transfusions for the non-bleeding subject with a platelet count $> 10,000/\text{mm}^3$, including factors such as platelet kinetics or factors that might alter platelet kinetics such as fever.

5.2.2.3 Neutropenia – growth factor guidelines

- Per ASCO guidelines (109), WBC growth factors are not recommended for afebrile neutropenia. However physicians may consider prophylaxis with filgrastim or pegfilgrastim for those subjects with severe neutropenia and known risk factors for neutropenic complications, including age > 65. Sargramostim (GM-CSF) should not be used because of its effect against prostate cancer (110-114), including in combination with ketoconazole in this patient population (115).

5.3 **Duration of Therapy and Criteria for Removal From Study**

In the absence of treatment delays due to adverse event(s), treatment may continue until one of the following criteria applies:

- Development of metastatic disease / Disease progression*,
- Intercurrent illness that prevents further administration of treatment,
- Unacceptable adverse event(s),
- Subject decides to discontinue treatment,
- Subject decides to withdraw from the study, or
- General or specific changes in the patient's condition render the patient unacceptable for further treatment in the judgment of the investigator.

* Subjects with biochemical progression only (rising PSA) should be encouraged to remain on study as long as there is no medical contraindication. Subjects who receive subsequent anti-cancer therapies prior to development of radiographic metastases should continue protocol follow up every 3 months (including scans). Subjects who withdraw from treatment to receive investigational agents should be encouraged to allow reporting of follow up of the primary and secondary endpoints such as development of metastatic disease and death. Subsequent anti-cancer therapies will be documented.

5.4 **Duration of Follow Up**

Patients will be followed for 3 years after removal from study or until death, whichever occurs first. Patients removed from study for unacceptable adverse events will be followed until resolution or stabilization of the adverse event.

6. **DOSING DELAYS/DOSE MODIFICATIONS**

6.1 **Ketoconazole**

Subjects experiencing grade 3 or 4 non-hematologic toxicities will have ketoconazole held until resolution to \leq grade 1 (The toxicity should be at least probably related to ketoconazole

and does not need to be held if toxicity is unrelated). Subjects experiencing \geq grade 3 non-hematologic toxicity that does not resolve to \leq grade 1 within 4 weeks will be removed from ketoconazole therapy. Subjects experiencing resolution to \leq grade 1 may resume ketoconazole at a lower dose (dose level -1). Further grade ≥ 3 toxicities will result in permanent discontinuation of ketoconazole. Dose reduction or discontinuation of ketoconazole for other reasons should be discussed with the study chair.

Dose Level	Agent / Dose
-1*	Ketoconazole 200 mg tabs 1 tab p.o. TID
0	Ketoconazole 200 mg tabs 2 tabs p.o. TID

****Subjects who require dose reduction of ketoconazole will have hydrocortisone continued or discontinued at the discretion of the investigator. Should subjects discontinue hydrocortisone, the dose should be tapered (suggestion: taper by 5 mg every three days).***

7. ADVERSE EVENT REPORTING REQUIREMENTS

Adverse event (AE) monitoring and reporting is a routine part of every clinical trial. The investigator will be required to provide appropriate information concerning any findings that suggest significant hazards, contraindications, side effects, or precautions pertinent to the safe use of the drug under investigation. Safety will be monitored by evaluation of adverse events reported by patients or observed by investigators or research staff, as well as by other investigations such as clinical laboratory tests, x-rays, electrocardiographs, etc.

7.1 Investigational Agent Risks

7.1.1 ¹⁷⁷Lu-J591 (No additional risks expected from ¹¹¹In-J591)

Radiolabeled J591 is likely to cause thrombocytopenia and/or neutropenia as well as anemia. Mild to moderate infusion reactions (fever, chills, rigors) are occasionally seen after administration. The following risks are possible after treatment with this experimental drug: allergic reactions, rash, hypotension, hypertension, renal insufficiency, liver enzyme elevations (ALT and/or AST), difficulty breathing and human anti-humanized antibody (HAHA) response.

Precautions/monitoring:

Subjects should receive pre-medication prior to Lu-J591 infusion as described in Section 5.2.3.1. During and after infusion, patients will be monitored for possible allergic reaction. Allergic events will be managed as follows: rash, pruritis, urticaria and wheezing will be treated with diphenhydramine hydrochloride, demerol and/or steroids as clinically appropriate. Anaphylaxis or anaphylactoid signs or symptoms will be treated with steroids and/or epinephrine as clinically indicated. Patients will be treated in a facility that is equipped for cardiopulmonary resuscitation. Infusion-related reactions

(fever, rigors) will be treated with acetaminophen, meperidine and diphenhydramine hydrochloride as clinically appropriate.

7.1.2 Ketoconazole

The most common side effects are weakness or lack of strength, gastrointestinal complaints such as nausea or vomiting, liver toxicity, skin reactions, and a potential risk of adrenal suppression.

Precautions/monitoring:

Subjects should take ketoconazole as described in Section 5.2.1. . Regular monitoring of liver enzymes is required. Ketoconazole is metabolized by the cytochrome P450 system and is a 3A4 substrate/inhibitor. Caution should be used with subjects on other medications metabolized by this system. Fatal arrhythmias have been reported in patients taking ketoconazole in combination with certain medications. See excluded medications in Section 5.2.1.

7.1.3 Hydrocortisone

Side effects of hydrocortisone include fluid retention (swelling), electrolyte imbalances (sodium and potassium), elevated glucose, elevated blood pressure, muscle weakness, bone loss, and skin changes.

7.2 Adverse Event Characteristics

- **CTCAE term (AE description) and grade:** The descriptions and grading scales found in the revised NCI Common Terminology Criteria for Adverse Events (CTCAE) version 4.0 will be utilized for AE reporting. A copy of the CTCAE version 4.0 can be downloaded from the CTEP web site (<http://ctep.cancer.gov>).
- **Attribution** of the AE:
 - **Definite** – The AE *is clearly related* to the study treatment. A reaction that follows a plausible temporal sequence from administration of the study drug and follows a known response pattern to the suspected study drug. The reaction can be confirmed with a positive re-challenge test or supporting laboratory data.
 - **Probable** – The AE *is likely related* to the study treatment. A reaction that follows a plausible temporal sequence from administration of the study drug and follows a known response pattern to the suspected study drug. The reaction cannot be reasonably explained by the known characteristics of the patient's clinical state or other modes of therapy administered to the patient.
 - **Possible** – The AE *may be related* to the study treatment. A reaction that follows a plausible temporal sequence from administration of the study drug and follows a known response pattern to the suspected study drug. The reaction might have been produced by the patient's clinical state or other modes of therapy administered to the patient.

- **Unlikely** – The AE *is doubtfully related* to the study treatment. The current state of knowledge indicates that a relationship is unlikely.
- **Unrelated** – The AE *is clearly NOT related* to the study treatment. No relationship between the experience and the administration of study drug; related to other etiologies such as concomitant medications or patient's clinical state.

7.3 Recording of Adverse Events

All adverse events will be recorded on a patient specific adverse event log. The AE log will be maintained by the research staff and kept in the patient's research chart.

7.4 Serious Adverse Event (SAE) Reporting

7.4.1. Definition of SAE

A serious adverse event (SAE) is any adverse event, occurring at any dose and regardless of causality that:

- Results in **death**.
- Is **life-threatening**. Life-threatening means that the patient was at immediate risk of death from the reaction as it occurred, i.e., it does not include a reaction which hypothetically might have caused death had it occurred in a more severe form.
- Requires inpatient **hospitalization or prolongation of existing hospitalization**. Hospitalization admissions and/or surgical operations scheduled to occur during the study period, but planned prior to study entry are not considered AEs if the illness or disease existed before the patient was enrolled in the trial, provided that it did not deteriorate in an unexpected manner during the trial (e.g., surgery performed earlier than planned).
- Results in **persistent or significant disability/incapacity**. Disability is defined as a substantial disruption of a persons' ability to conduct normal life functions.
- Is a **congenital anomaly/birth defect**.
- Is an **important medical event**. An important medical event is an event that may not result in death, be life-threatening, or require hospitalization but may be considered an SAE when, based upon appropriate medical judgment, it may jeopardize the patient or subject and may require medical or surgical intervention to prevent one of the outcomes listed in the definitions for SAEs. Examples of such medical events include allergic bronchospasm requiring intensive treatment in an emergency room or at home, blood dyscrasias or convulsions that do not result in inpatient hospitalization, or the development of drug dependency or drug abuse.

Clarification should be made between the terms “serious” and “severe” since they ARE NOT synonymous. The term “severe” is often used to describe the intensity (severity) of a specific event (as in mild, moderate, or severe myocardial infarction); the event itself, however, may be of relatively minor medical significance (such as a severe headache). This is NOT the same as “serious,” which is based on patient/event outcome or action criteria described above and are usually associated with events that pose a threat to a patient’s life or functioning. A severe adverse event does not necessarily need to be considered serious. For example, persistent nausea of several hours duration may be considered severe nausea but not an SAE. On the other hand, a stroke resulting in only a minor degree of disability may be considered mild, but would be defined as an SAE based on the above noted criteria. Seriousness (not severity) serves as a guide for defining regulatory reporting obligations.

7.4.2. Reporting of SAE to IRB

All SAEs occurring on this study will be reported to the IRB according to the policies of the local IRB. For WCMC patients, reportable SAEs will be reported on the institutional SAE reporting form and comprehensive AE & IND Reporting table. These forms may be downloaded at

http://www.med.cornell.edu/research/for_pol/ins_rev_boa.html

For all other institutions: SAE’s will be reported to the local IRB per the institutional guidelines.

7.4.3. Reporting of SAE to Weill Cornell Medical College

Institution will notify Weill Cornell Medical College of all serious adverse events that occur within 24 hours of investigator notification by contacting Dr. Scott Tagawa’s office at 646-962-2072. A written SAE report should be filed with the local IRB in accordance with the institutional guidelines. The following forms must be emailed to guonc@med.cornell.edu and/or faxed to Weill Cornell Medical College Clinical Trials Office at 646-962-1611 within five (5) business days of investigator notification:

- Completed MedWatch Form
- Completed WCMC SAE Cover Sheet

Note that specified AE/SAE’s such as thrombocytopenia or bleeding are required to be reported within 24 hours. The Principal Investigator and Medical Monitor will review all SAEs and copies of all SAEs will be electronically distributed to all participating site for submission to the local IRB.

7.4.4. Reporting of SAE to FDA

If an SAE occurs on this study, the event will be filed on a MedWatch form with the FDA. All completed MedWatch forms will be sent to WCMC for submission to the FDA.

7.5 Secondary AML/MDS

Myelodysplastic syndrome and acute myeloid leukemia has been reported in patients previously treated with anti-CD20 based RIT for non-hodgkin's lymphoma. Some case reports and small series have raised concern for this phenomenon after RIT (116). However, given the increased incidence of MDS/AML in this population, either because of their underlying illness or of their exposure to previous cytotoxic therapy (especially alkylating agents), there is no good evidence to suggest that there is a significantly increased risk than of a similar population of patients not receiving RIT (117, 118). However, based upon the theoretical increased risk, the incidence of MDS/AML during follow up will be noted and used to increase the investigators' experience and knowledge. Any suspected potential increased risk of MDS/AML will be reported to the IRB and DSMB.

8. PHARMACEUTICAL INFORMATION

A list of the adverse events and potential risks associated with radiolabeled J591 can be found in Section 7.1.

8.1 Investigational Agent (IND#11,613)

Radiolabeled J591 (¹⁷⁷Lu-J591 and ¹¹¹In-J591) are an investigational agents supplied to investigators by Weill Cornell Medical College. Ketoconazole and hydrocortisone are commercially available and should be prescribed as indicated above (see Section 5.1).

8.2 Radiolabeled J591 Ordering

Upon enrollment, sites will notify the WCMC Study Coordinator of the proposed D29 radiolabeled J591 infusion date. The WCMC Study Coordinator will arrange for shipment of the radiolabeled antibody to the treatment site. After confirmation of the date of infusion at the D15 telephone follow up, the site will confirm treatment date with the WCMC Study Coordinator and shipment to the site's nuclear medicine department will be confirmed.

8.3 Drug Accountability

The case report forms relating to the preparation, quality control and drug accountability will be completed by the radiochemists in nuclear medicine.

Test articles:

- a) mAb HuJ591, 5 mg/ml (non-radioactive, non-DOTA conjugated naked antibody),
- b) DOTA-HuJ591-GS, 8.0 mg/ml (non-radioactive antibody for labeling with ¹⁷⁷Lu)

Storage: The primary inventory of test articles is stored at Goodwin Biotech, Plantation, FL, a cGMP, FDA-approved facility. This storage facility is monitored around the clock and is equipped with back-up power generators in the event of a power outage. Periodically, as needed, vials of the test articles are shipped to WMC Urologic Oncology where they are stored in a locked, monitored, centrally alarmed refrigerator. Access to the storage area in WMC Urologic Oncology is limited by ID card-required access and a locked refrigerator with a key controlled by the WMC Urologic Oncology Lab administrator (Lana Winter).

Inventory: An official inventory record is kept and updated in real time. On the day of radiolabeling and dose administration to the patient, the radiochemists remove the test articles from the refrigerator and record the number of vials removed from the inventory and the number remaining in the official inventory record. These records are kept in WMC Urologic Oncology.

The “test article”, ^{177}Lu -J591, is prepared by the radiochemists in the Nuclear Medicine laboratory. The radionuclides are received and stored in the nuclear medicine department according to the procedures established by the Institutional Radiation Safety Office. The radiolabeling and quality control data on radiochemical purity, immunoreactivity, sterility and pyrogenicity tests are kept in nuclear medicine. Radiolabeled antibody preparations are kept refrigerated until use.

Disposal: Unused radiolabeled antibody preparations are stored in lead containers for decay and subsequently disposed of according to standard radiation safety guidelines. Unused non-radioactive antibody vials and partially used vials (test articles) are destroyed or recycled to the WMC Urologic Oncology research lab for non-clinical research purposes.

9. CORRELATIVE/SPECIAL STUDIES

9.1 Laboratory Correlative Studies

Additional Correlative Tests will be performed during the trial and will be centrally analyzed.

Only the materials (tubes, shipping box, FedEx airbill) for CTC counts via CellSearch methodology will be provided to the site following site activation. Additional materials should be requested directly by emailing GUONC@med.cornell.edu. The site should use their own supplies for the remainder of the tests.

A unique ID (number) for the Adrenal Androgen, CTC, Plasma markers, Archival Tumor, and HAHA samples will be provided by WCMC via email. Please contact GUONC@med.cornell.edu prior to the date of sample collection (if possible) for the unique ID. Please use the number provided to write it on the label and the lab requisition. The material shipment for these samples should be provided by site.

Please notify GUONC@med.cornell.edu when shipping samples, and provide the tracking number. A Requisition form should be completed (as described in the Lab Manual) detailing the samples that are being shipped for all samples except the CTC counts via CellSearch methodology.

Note: Plasma markers (9.1.2) are the only tests that are optional. All other correlative samples are required. The collection of archival tissue may be waived if no tissue is available.

9.1.1 Adrenal Androgen Levels

Serum levels of adrenal androgen levels will be obtained at screening (any time following consent and prior to therapy initiation on C1D1), Cycle 2 Day 1, and at the time of PSA progression. Collect 10 mL of peripheral blood in a yellow (SST) or red top tube. Label samples with the unique sample number that will be provided by the Weill Cornell Medical College study coordinator to ensure that laboratory personnel will be blinded to subject and clinical data.

Please refer to the Lab Manual for further details on collecting, handling and shipping of adrenal androgen samples.

9.1.2 Plasma markers of hemostatic activation, fibrinolysis, and angiogenesis (optional)

Plasma samples will be collected on C1D1 prior to therapy (may be collected as part of screening within 1 week of C1D1), Cycle 2 Day 1 (prior to J591 administration), Cycle 3 Day 1, at PSA progression, and at end of study. Refer to the Lab Manual for further details on collecting blood samples for plasma markers. Samples will be labeled with a unique sample ID number to ensure that laboratory personnel will be blinded to subject and clinical data.

Refer to the Lab Manual for details on handling and shipping of blood samples for plasma markers.

* Plasma markers are the only tests that are optional.

9.1.3 Circulating tumor cells

Circulating tumor cells (CTCs) will be assessed in the following manner:

- CTC counts via CellSearch methodology
- CTC analysis for research

9.1.3.1 Collection of specimens for CTC counts (enumeration) via CellSearch Methodology:

Kits (including requisition and FedEx airbill) will be provided for CTC samples for counts via CellSearch methodology. At specified time points [baseline C1D1 prior to ketoconazole, C2D1 (prior to Lu-J591), C3D1, at the time of PSA progression, and at end of study] samples for CTC count via CellSearch methodology will be collected. Use the label from the requisition and place it on the tube to ensure that laboratory personnel will be blinded to subject and clinical data. The name should be the unique ID provided by WCMC coordinator (**NOT** the patient name). Refer to the Lab Manual for further details on collecting, handling and shipping of blood samples for CTC counts via CellSearch methodology.

9.1.3.2 Collection of specimens for CTC analysis for research:

At specified time points (screening/baseline at C1D1 prior to treatment and at end of study), blood samples will be collected as described in the Lab Manual. No Kit will be provided for this test, sites should use their own materials. Samples will be labeled with a unique sample ID number to ensure that laboratory personnel will be blinded to subject and clinical data.

Refer to the Lab Manual for further details on handling and shipping of blood samples for CTC analysis for research.

9.1.3 Human Anti-Humanized Antibody (HAHA) specimen:

Blood samples will be collected at screening and EOS. Refer to the Lab Manual for further details on collecting, handling and shipping of blood samples for HAHA.

9.1.4 Archival Tumor PSMA expression

9.1.4.1 Specimens

At the screening visit, paraffin-embedded tumor blocks or 10 unstained slides with representative tumor tissue will be collected as described in the Lab Manual. Samples will be labeled with a unique sample ID number to ensure that laboratory personnel will be blinded to subject and clinical data.

For shipping instructions, please refer to the Lab Manual.

9.2 Special Studies

9.2.1 Radiolabeled-J591 Imaging

9.2.1.1 Assessment

9.2.1.1.1 Method of Assessment:

Planar imaging will be performed 2-8 days after radiolabeled-J591 administration (scan window will be assigned at randomization). In the case of a suspicious lesion, SPECT of the area may be performed at the nuclear med physician's discretion. In addition a CT/MRI may be obtained for possible confirmation. Identified sites will be followed on subsequent imaging modalities (bone scan, CT or MRI) to define the interval between identification of the lesion/s by radiolabeled-J591 versus other modalities. Images will be captured as specified in the Imaging Manual and provided to WCMC on disc in dicom format.

9.2.1.1.2 Timing of Assessment

J591 scanning will be performed approximately 2-3 or 6-8 days after J591 administration (scan date will be assigned with randomization). Scans will be assessed centrally at WCMC.

10. STUDY CALENDAR

The study flow chart, including all procedures to be performed during the study, is presented below. Prior to engaging in any study procedure, each patient must sign and date an informed consent form.

Baseline evaluations are to be conducted within *1 week* prior to administration of protocol therapy. Scans and x-rays must be done *within one month* of enrollment (or following enrollment as part of screening).

Study Procedure	Screening Period												
	V1	V2	V3 ⁸	V4	±	V5	V6	V7	V8	V9	F/U ¹⁴	PSA progression	EOS ¹¹
	Day -28 to -1	C1D1	C2D1	C2 D3-9	C2D22	C3D1	C3D8	C3D15	C3D22	C4D1	Every 4 weeks		
Informed consent	X												
Medical History	X	X ⁺⁺	X ⁺⁺			X ⁺⁺				X ⁺⁺	X ⁺⁺	X ⁺⁺	X ⁺⁺
Physical Exam (PE)- Complete	X											X	X
PE – Targeted ⁹		X	X			X				X	X		
Vital Signs ¹⁰	X	X	X ⁺			X				X	X	X	X
Demographics	X												
Previous Therapy Report	X												
Performance Status	X	X	X			X				X	X	X	X
Height, weight	X	X	X			X				X	X	X	X
CBC with differential + platelet count ^{2,3}	X	X	X		±	X	X ³	X ³	X ³	X	X	X	X
PT or INR, PTT	X												
Electrolytes, BUN, Creatinine	X	X	X			X				X	X	X	X
Total protein, albumin, calcium	X		X			X				X	X	X	X
total bilirubin, AST	X		X			X				X	X	X	X
ALT, LDH, Alk Phos	X		X			X				X	X	X	X

PSA ⁴	X	X	X			X				X	X	X	X
Testosterone	X											X	X
Urinalysis	X												
Human anti-J591 antibody	X												X
EKG	X												
CT or MRI (abdomen-pelvis) ¹	X										X		
Bone Scan ¹	X										X		
CXR ¹	X										X		
J591 scan				X*									
Adverse Events	X	X	X	X		X				X	X	X	X
FACT-P ¹³		X ¹³									X ¹²	X ¹²	X ¹²
Concomitant Medications	X	X	X			X				X	X	X	X
Concomitant Procedures		X	X			X				X	X	X	X
¹¹¹ In/ ¹⁷⁷ Lu-J591 Administration			X ¹²										
Ketoconazole/Hydrocortisone ⁷		X	X	X		X	X	X	X	X	X	X	
Plasma Markers		X	X			X						X	X
Circulating Tumor Cells ⁵		X	X			X						X	X
Adrenal Hormones		X ⁶	X ⁶									X ⁶	
Archival Tissue	X												

A phone assessment will be performed on D15 +/- 3 days to assess compliance and toxicity of ketoconazole/hydrocortisone.

± CBC on D50 +/- 2 days is required for pts on anticoagulation or NSAIDS, suggested in pts with baseline plt count < 200

*J591 scan may be done 2-8 days after infusion (date will be assigned upon randomization). SPECT studies of sites of disease will be obtained in selected patients as necessary.

+ vital signs to be taken prior to infusion and post-infusion as per Section 5.1.3.3

++ interval medical history

¹ Baseline radiographic evaluation should be performed within one month of enrollment (or following enrollment as part of screening). Subsequent scans (CT/MRI abd/pelvis, CXR (or CT chest), and bone scan) should be performed every 6 months until PSA progression, then every three months thereafter unless clinically indicated sooner.

² CBC repeated twice a week when platelets <25,000/mm³ and/or ANC <500/mm³

³ CBC's not associated with study visits may be performed at any CLIA certified laboratory

⁴ The same lab should be used for all study PSA's if possible

⁵ CTC counts via CellSearch (using kit) at C1D1 prior to ketoconazole, C2D1 (prior to Lu-J591), C3D1, at the time of PSA progression, and at end of study. Additional blood samples for CTC analysis for research will be drawn at C1D1 prior to treatment and at end of study

⁶ Adrenal hormone levels should be drawn prior to starting treatment on Cycle 1, Day 1, 1 month, and at PSA progression

⁷ Starting after C1D1 assessment and blood draw until toxicity, investigator, or patient decision as per Sections 5.2.1, 5.2.2, 6.1. Distribute medication diary at the beginning of each cycle.

⁸ Visit 3 (C2D1): Targeted physical exams can be completed the day prior to the scheduled J591 infusion date.

- ⁹ All references to targeted physical exams throughout the protocol include a heart and lung examination, as well as evaluation of any abnormalities found during the complete physical exam performed at screening
- ¹⁰ Vital signs include temperature, heart rate, blood pressure, and respiratory rate.
- ¹¹ The End of Study Visit occurs when patient shows evidence of metastatic disease. Patient remains on trial until documented metastatic disease. In addition to scans a biopsy can be performed to prove metastatic disease. Patient can receive additional therapy prior to showing metastatic disease and still remain on trial. Site will be asked for information regarding the additional therapy in the case report forms.
- ¹² In the event that the J591 infusion is delayed, cycle 1 will be extended until the date of the J591 infusion. The date of the J591 infusion will be considered Cycle 2, Day 1.
- ¹³ The FACT-P questionnaire should be completed after enrollment, but prior to therapy (on CID1 prior to ketoconazole). Questionnaires should also be completed at each radiographic assessment point (q6 months prior to PSA progression, q3 months after PSA progression) – may be performed just prior to scan, on day of scan, or after scan, but BEFORE results of scans are discussed. In addition, FACT-P will be completed at PSA progression and EOS
- ¹⁴ Follow up is at least every 4 weeks while on ketoconazole and until study drug toxicities have resolved (with the exception of anemia). Following discontinuation of ketoconazole, follow up is at least every 12 weeks (or 3 months)

10.1 STUDY PROCEDURES: Schedule of Events

The assessments to be performed during the study are outlined below by study period, visit and day. Study assessments through Visit 9 (Day 85) will be completed within ± 3 days of the specified day for the visit, except where noted. Visits after Day 169 will be performed within ± 7 days of the scheduled visit.

Screening Period (Visit 1, Days -28 to -1) – All subjects

The procedures outlined for Visit 1 must be completed prior to the patient receiving study drug. The following procedures will be conducted at Visit 1:

- Informed Consent
- Medical History
- Concurrent medications
- Complete Physical Exam
- Vital Signs
- Demographics
- Previous therapy
 - Surgical report will include date and type of surgery +/- lymphadenectomy
 - Radiotherapy report will include modality of therapy with prescribed dose and field and dates of therapy
 - Previous hormonal therapy – drugs, doses, dates of therapy
 - Continuous vs intermittent therapy
- ECOG Performance Status
- Height, Weight
- CBC with differential and platelet count.
- PT or INR, PTT
- Electrolytes, BUN, Creatinine
- Total protein, albumin, calcium, total bilirubin, AST, ALT, LDH
- PSA

- PSA DT Calculation
- Alkaline phosphatase
- Testosterone
- Human anti-J591 antibody sample (may also be drawn C1D1 prior to initiation of study drugs)
- Urinalysis
- Archival Tissue (section 9.1.4) - Paraffin-embedded tumor blocks or 5 unstained slides with representative tumor tissue
- EKG, up to 1 month prior to treatment
- CT or MRI (abdomen-pelvis), up to 4 weeks prior to enrollment
- Bone scan, up to 4 weeks prior to enrollment
 - Any confirmatory tests to assess equivocal results of bone scan should also be completed within 4 weeks of enrollment
 - CXR, up to 4 weeks prior to enrollment (if CT chest has been performed within 4 weeks of enrollment, this procedure is waived)

Evaluations and procedures at Visit 2 (C1D1) – All subjects

Following screening procedures, eligible patients will be dosed with ketoconazole and hydrocortisone. See Section 5.1 for details on the dose and administration.

The following assessments are to be collected prior to drug administration unless otherwise noted:

- Interval medical history
- Targeted Physical Examination with vital signs
- ECOG PS
- CBC with differential and platelet count*
- Electrolytes, BUN, Creatinine*
- PSA*
- Adrenal hormone levels
- Plasma markers
- CTC's

- Adverse Events
- Concomitant medications
- Concomitant procedures
- FACT-P questionnaire (prior to ketoconazole/hydrocortisone administration)
- Ketoconazole/hydrocortisone administration instruction (re-inforcement) – prescriptions should have been filled prior to this visit, but no drugs should have been taken prior to blood draw D1
 - Distribute Medication Diary

*Note that treatment day labs are used for baseline (not for assessment of eligibility), though subjects may be withdrawn from the study for safety concerns per the investigator's discretion.

Phone Assessment (Cycle 1, Day 15 +/- 2 days) – All subjects

- Compliance
- Toxicity screening
- Next visit reminder (confirmation of date/time of next visit with J591 infusion should also be confirmed after delivery date of drug is confirmed)

Evaluations and procedures at Visit 3 (C2D1) – All subjects

Following assessment, eligible, randomized patients who have not come off trial for toxicity or noncompliance will be dosed with radiolabeled-J591. See section 5.2.3 for details on the administration.

Note: The J591 infusion days should be scheduled on a Thursday or Friday. If needed, visits can be scheduled on a Wednesday afternoon but the earliest the site will receive drug is Wednesday at noon. Because of the nature of study drug and shipping, dosing outside of specified window should be discussed with WCMC, but will not require a protocol exception provided the date has been pre-approved by WCMC. The exact date of the J591 infusion will be confirmed 2 weeks prior. The site is not responsible for ordering the J591. WCMC will handle ordering and shipping the drug. The shipping material needs to be sent back to WCMC. A return air bill will be included with the shipment.

Note: In the event that the J591 infusion is delayed, cycle 1 will be extended. The date of the J591 infusion will be considered cycle 2, day 1.

Patients will remain at the clinical site for a minimum of 2 hours after completion of radiolabeled-J591 administration to monitor vital signs. The patient should be considered clinically stable by the investigator prior to discharge. The following assessments are to be collected prior to drug administration unless otherwise noted:

- Interval medical history
- Targeted Physical Examination
- ECOG Performance Status
- Vital Signs (pre-infusion, post infusion as per Section 5.1.3.3)
- Verification of ketoconazole/hydrocortisone administration, Collection/Distribution of diary
- CBC with differential and platelet count*
- Electrolytes, BUN, Creatinine*
- PSA*
- Total protein, albumin, calcium, total bilirubin, AST, ALT, LDH
- Alkaline phosphatase
- Plasma markers
- Adrenal hormones
- CTC's
- Concomitant medications
- Concomitant/interval procedures
- Adverse events (pre- and post- infusion)

*Note that treatment day labs are used for radiolabeled-J591 baseline (not for assessment of eligibility)

Evaluations and procedures at Visit 4/J591 Scan (C2D3-9)

- Adverse Events
- Concomitant medications
- Concomitant/interval procedures
- J591 imaging (2-8 days after infusion). At selected study sites, whole body planar radionuclide images will be obtained between 2-8 days post-J591 treatment. The date of scan (3 or 4 days vs 6-8 days after J591 infusion) will be assigned at the time of

randomization. SPECT studies of sites of disease will be obtained in selected patients as appropriate. These will be used to assess the ability of radiolabeled J591 to image metastatic sites that do not appear on conventional imaging modalities (bone scan, CT/MRI).

Evaluations and procedures C2D22 (safety CBC for some subjects)

For subjects on aspirin/NSAIDs with anti-platelet properties or anticoagulation, a CBC on approximately Day 50 is **required** (3 weeks +/- 2 days after radiolabeled J591 infusion). For all other subjects, in particular subjects with baseline platelet counts < 200/mm³ a CBC at this timepoint is suggested, but not required.

- CBC with differential †

Evaluations and procedures C3D1

- Interval medical history
- Targeted Physical Examination
- Vital Signs
- ECOG Performance Status
- Verification of ketoconazole/hydrocortisone administration, Collection/Distribution of diary
- Adverse Events
- Concomitant medications
- Concomitant/interval procedures
- CBC with differential and platelet count.
- Electrolytes, BUN, Creatinine
- Total protein, albumin, calcium
- Total bilirubin, AST, ALT, alkaline phosphatase, LDH
- PSA
- Plasma markers
- CTCs

Evaluations and procedures Cycle 3 D8 *†

- CBC with differential and platelet count

Evaluations and procedures Cycle 3 D15 *†

- CBC with differential and platelet count†

Evaluations and procedures Cycle 3 D22 *†

- CBC with differential and platelet count†

All CBC results during cycle 3 must be either entered into the REDCap eCRF database or emailed to guonc@med.cornell.edu within 24 hours of testing.

***Lu-J591 subjects with platelets < 25,000 and/or ANC < 500 are required to have CBC's performed at least twice per week until recovery to platelets > 25,000 and ANC > 500**

† Lu-J591 CBC evaluations may be performed at approved CLIA certified local laboratories with PI's pre-approval

Evaluations and procedures C4D1 – ALL PTS

- Adverse events
- Concomitant medications
- Concomitant/interval procedures
- Verification of ketoconazole/hydrocortisone administration, Collection/Distribution of diary
- Interval Medical History
- Targeted Physical Exam
- Vital Signs
- ECOG Performance Status
- Weight
- CBC with differential and platelet count.
- Electrolytes, BUN, Creatinine

- Total protein, albumin, calcium, total bilirubin, AST, ALT, LDH
- PSA
- Alkaline phosphatase

J591 subjects who have not yet recovered ANC > 1.5 and/or platelet counts > 150 by Visit 9 (Cycle 4 D1) will continue to have CBC's checked weekly until these criteria satisfied or until permission is granted by the Study Chair

Evaluations and procedures q4 weeks while on ketoconazole and until resolution of study drug toxicities with the exception of anemia until EOS

- Adverse events
- Concomitant medications
- Concomitant/interval procedures
- Verification of ketoconazole/hydrocortisone administration, Collection/Distribution of diary
- Interval Medical History
- Targeted Physical Exam
- Vital Signs
- ECOG Performance Status
- Weight
- CBC with differential and platelet count.
- Electrolytes, BUN, Creatinine
- Total protein, albumin, calcium, total bilirubin, AST, ALT, LDH
- PSA
- Alkaline phosphatase
- Other laboratory assessments and procedures as clinically indicated.

NOTE: For individual subjects deemed to be tolerating ketoconazole well, following 6 months on study (after scans) study evaluations need to be performed by official study investigators at official study sites only every 12 weeks. For those subjects who are

tolerating study drug well (in the opinion of the investigator) and for whom travel is a burden, the other two q4 week evaluations may be performed by a local lab with either local physician and/or phone assessment for adverse events (i.e. at least every third visit must be done on site by official study investigators). In this case, source documents should be collected and drug diaries may be collected by fax/mail/email. Subjects who discontinue ketoconazole for any reason may be followed every 12 weeks following resolution of ketoconazole and study drug toxicities (except anemia).

Radiographic Evaluation and Patient Reported Outcome Evaluation

- Bone scan, CT/MRI abdomen/pelvis, and CXR + FACT-P[#] at baseline
- Bone scan*, CT/MRI of abdomen/pelvis, and CXR + FACT-P[#] will be repeated every 6 months in the absence of biochemical or clinical progression
- Bone scan*, CT/MRI of abdomen/pelvis, and CXR + FACT-P[#] will be repeated every 3 months subsequent to biochemical or clinical progression
- In addition, a bone scan will be performed for subjects with clinical signs or symptoms of bone metastases at the investigators discretion

*During the first 6 months, bone scan progression requires confirmation by a 2nd bone scan. The date of progression is defined as the date of the 1st scan that is subsequently confirmed to be positive.

[#]FACT-P to be administered either prior to imaging or following imaging, but before results of scans are disclosed to subject.

Evaluations and procedures at PSA progression

Note: subjects may remain on ketoconazole/hydrocortisone beyond PSA progression at the discretion of the investigator and/or their treating physician

- Adverse events
- Concomitant medications
- Concomitant/interval procedures
- Verification of ketoconazole/hydrocortisone administration, Collection of diary
- Interval Medical History
- Complete Physical Exam
- Vital Signs

- ECOG Performance Status
- Weight
- CBC with differential and platelet count.
- Electrolytes, BUN, Creatinine
- Total protein, albumin, calcium, total bilirubin, AST, ALT, LDH
- Alkaline phosphatase
- PSA
- Testosterone
- Plasma markers
- CTC's
- Adrenal hormones
- Other laboratory assessments and procedures as clinically indicated.
- FACT-P

Evaluations and procedures at End of Study (EOS = development of metastatic disease on scans)

Note: subjects may remain on protocol past initial scans with evidence of metastatic disease if confirmatory scans are warranted

- Adverse events
- Concomitant medications
- Concomitant/interval procedures
- Verification of keto/hydrocortisone administration, Collection of diary (if relevant)
- Interval Medical History
- Complete Physical Exam
- Vital Signs
- ECOG Performance Status

- Weight
- CBC with differential and platelet count.
- Electrolytes, BUN, Creatinine
- Total protein, albumin, calcium, total bilirubin, AST, ALT, LDH
- Alkaline phosphatase
- PSA
- Testosterone
- Plasma markers
- CTC's
- Human anti-J591 antibody sample
- Other laboratory assessments and procedures as clinically indicated.
- FACT-P

11. MEASUREMENT OF EFFECT

11.1 Primary Endpoint: Proportion free of radiographically evident metastases at 18 months. Bone scans with <3 metastatic lesions should be confirmed with CT/MRI or a repeat scan >4 weeks after the initial scan. Should a subject require confirmatory scans, the date of radiographic progression will be the date of the initial scan showing suspicion of metastasis.

11.1.1 Metastasis-free survival

Time to development of metastatic disease will be calculated from the date of treatment to the date of the first radiographic evidence of metastatic disease. Bone scans with <3 metastatic lesions should be confirmed with CT/MRI or a repeat scan >4 weeks after the initial scan. Should a subject require confirmatory scans, the date of radiographic progression will be the date of the initial scan showing suspicion of metastasis.

11.2 Response Criteria

11.2.1 Biochemical (PSA) response

A PSA decline of $\geq 50\%$ has been demonstrated to correlate with improved survival in advanced castrate disease (119). In addition, Scher, et al have demonstrated that a PSA which either declines or shows no increase from baseline at either 8 or 12 weeks after initiating therapy correlates with improved survival compared to patients whose PSA

risks despite therapy (120). Both of these criteria ($\geq 50\%$ PSA decline and no increase from baseline) will be recorded.

PSA response will be determined by comparing the PSA levels after therapy to the baseline, pre-treatment PSA. A decline of $\geq 50\%$, confirmed by a second PSA value ≥ 2 weeks later, should be reported. Patients must not demonstrate clinical or radiographic (CT and/or MR) evidence of disease progression during this time period.

Analyses of phase III trials of docetaxel versus mitoxantrone chemotherapy in men with metastatic androgen independent prostate cancer have shown that a 30% decrease in PSA levels is most strongly associated with a treatment effect on overall survival (52, 53). A PSA decline of $\geq 30\%$ will be assessed and used for exploratory analysis in the prediction of time to metastatic disease and overall survival.

11.2.2 Duration of PSA response

Duration of PSA response is defined as the time from the first 50% (or 30%) PSA decline until the PSA value is confirmed to increase by 25% above the nadir, provided that the increase is at least 2 ng/mL above nadir.

11.2.3 Progression (see also 11.1)

11.2.3.1 Biochemical progression

Biochemical (PSA) progression is defined as a PSA measured ≥ 12 weeks after treatment which is confirmed (by a repeat assay) to rise $\geq 25\%$ above the baseline, pre-treatment value AND ≥ 2 ng/mL. In the case of a patient whose PSA declines after therapy, PSA progression is defined as a rise in PSA $\geq 25\%$ above the nadir value AND ≥ 2 ng/mL. The time of progression is determined using the date of the 1st (subsequently confirmed) PSA $\geq 25\%$ above baseline or nadir. PSA rise < 12 weeks of initiating treatment is not considered to be progression.

11.2.3.2 Time to biochemical progression

Time to PSA progression is defined as the interval between initiating treatment until the PSA rises 25% above nadir provided that the increase is at least 2 ng/mL

11.2.3.3 Time to PSA progression above baseline

Time to PSA progression above baseline will also be recorded. Time to PSA progression above baseline will be defined as the interval between initiating treatment until the PSA rises above the pre-treatment baseline by at least 2 mg/mL. PSA rise < 12 weeks of initiating treatment is not considered to be progression.

12. DATA REPORTING / REGULATORY CONSIDERATIONS

12.1 Data Collection and Monitoring

The data collection plan for this study is to utilize a user ID/password protected encrypted database created by the WCMC CTSC to capture all treatment, toxicity, and efficacy data for all enrolled patients. Electronic CRF's (case report forms)

utilizing unique study ID numbers to minimize potential exposure of PHI will be completed on an ongoing basis by all sites.

The study will be monitored by Weill Cornell Medical College. Data integrity will occur via electronic and fax queries. A review of the majority of source documents to verify CRF integrity is planned for the initial subject treated at each site. Further electronically collected data will be reviewed in real time and electronic queries will be sent. Weill Cornell reserves the right to site audits as necessary. In the event this will occur, the site will be given ample notice prior to the visit.

12.2 Regulatory Considerations

All protocol amendments and consent form modifications will be made by the Study Chair. Weill Cornell will have the opportunity to review and approve the changes prior to submission of these changes to the Weill Cornell IRB and distribution to participating sites.

12.3 Data Safety Monitoring Board

This study will utilize the Weill Cornell Medical College (WCMC) Institutional Data Safety Monitoring Board (DSMB) and follow its policies and procedures for monitoring this double-blinded study for safety concerns, with ongoing updates from the Study Chair on an ongoing basis. The interim analysis will be performed by the DSMB and the decision to proceed or stop the trial will be provided to the Study Chair.

The Weill Cornell DSMB is comprised of medical specialists and advisors on human rights issues in human subjects research. The DSMB currently has 9 members, meets at quarterly intervals during the year, and carries out ongoing review of protocols submitted throughout the year. Once a protocol has been submitted and approved by the Institutional Review Board (IRB) and is recommended for oversight by the DSMB, the Board determines if the protocol will be reviewed quarterly, semi-annually, or annually.

The DSMB evaluates the accumulated data from the study in order to monitor the safety of subjects throughout the trial and reviews the risks and benefits, as well as the efficacy, of the study. The DSMB will also evaluate the overall trial conduct and progress. Ultimately, the DSMB validates the continuation of the trial or determines if a study needs modification or termination.

Reports to the DSMB will include the following items for review:

1. Completed DSMB Periodic Review Form.
2. Synopsis of the study to date.
3. IRB approved consent form.
4. IRB current protocol.
5. Summary table of study results.
6. Adverse event table.

7. Data safety monitoring plan.

Safety monitoring is carried out to ensure and maintain the scientific integrity of human subject research projects and to protect the safety of human subjects. Safety monitoring can be viewed as any process during a clinical trial that involves the review of accumulated outcome data for groups of patient-subjects to determine if any of the treatment procedures practiced should be altered or stopped. NIH Guidelines (1998, 2000) specify that all clinical trials should have a system in place for appropriate oversight and monitoring to ensure the safety of participants and the validity of the data.

Monitoring activities will be commensurate with the nature, size, and complexity of the trial in accordance with institutional policies and will be determined after IRB and DSMB review of the protocol immediately prior to study activation. For a small, single-center study, the monitoring is usually performed by a statistician in conjunction with a Safety Officer. For those single-site, high risk trials, a DSMB may be appropriate. For larger, single or multi-site studies, the monitoring is usually performed by a committee, often called a Data Safety Monitoring Board (DSMB). Ongoing review of the data by an independent individual or committee assures the investigators, the IRB, the study's sponsor, and the funding agency that the trial can continue without jeopardizing subjects' safety.

Weill Cornell Medical College requires that all research approved by the WCMC IRB include an appropriate plan for the monitoring of data to ensure the safety of human subjects. Research supported by Federal agencies will be monitored according to all regulations and guidelines of the relevant Federal agency.

12.4 Initial Safety Review

¹⁷⁷Lu-J591 has been shown to be safe at a dose of 70 mCi/m² in a phase I dose-escalation trial and a multicentered phase II trial. Because the major toxicity (myelosuppression) is at least in part due to the location of metastases (cortical bone and bone marrow), it is expected that the toxicity in this study population will not exceed that seen in the trials in metastatic CRPC. However, safety data will be monitored on a real-time basis by the Study Chair and shared with the core study investigators. Should there be > 1 subject experiencing a stopping rule as defined by agreement with the FDA during the conduct of the phase II trial in metastatic CRPC (see Appendix B) within the initial 9 subjects (approximately 6 subjects receiving ¹⁷⁷Lu-J591), enrollment will be halted pending DSMB review. Enrollment will continue without a pause during the ongoing safety analysis. Completion of initial safety review is anticipated to be completed in summer, 2011.

12.5 Analysis and Data Reporting

Secondary endpoints examining the patient population or treatment with ketoconazole/hydrocortisone without regard to the study drug (radiolabeled J591)

may be analyzed without breaking the blinding procedures on an ongoing basis and may be reported during the conduct of the study.

13. STATISTICAL CONSIDERATIONS

13.1 Study Design/Endpoints

The study is a randomized phase 2 study with a 2:1 ratio favoring ^{177}Lu -J591, with stratification by investigational site and mode of primary therapy (radiation vs surgery). Randomization will be performed by using a series of randomized blocks of 6 within each participating site/primary therapy stratum (with a 2:1 allocation ratio). This will provide assurance that after six patients are enrolled in any given participating site/primary therapy stratum, there will be four patients assigned to the combination regimen (Group 1) and two patients assigned to the single regimen (Group 2). This procedure will allow for each site to contribute similar numbers of ^{177}Lu -J591/ketoconazole patients and ^{111}In -J591 (placebo)/ketoconazole patients within the defined participating site/primary therapy strata.

The primary endpoint is the proportion free of metastases in each group at 18 months. Ninety-five percent confidence intervals (95% CI) will be estimated for the 18-month MFS proportion in both groups via binomial proportions. The MFS proportion will also be descriptively evaluated at 12, 24, 30, and 36 months in each group.

MFS will be measured from the start of the treatment to the date of either documentation of metastatic disease or death. All treated patients will be observed for a minimum of 18 months. The 18-month MFS proportion with ketoconazole + ^{111}In -J591 has been estimated to be 50% {521 Smith, M.R. 2005}; therefore, the target 18-month MFS proportion for the combination of ketoconazole + ^{177}Lu -J591 regimen is hypothesized to be 80%. An intent to treat analysis will include all randomized subjects. However, we will also analyze subjects who received study-drug. This subset will be those subjects who met eligibility requirements, have initiated therapy, and were not removed from the study for non-compliance or patient withdrawal within the first 4 weeks, and received infusion of study drug.

With approximately 34 patients in the ketoconazole+J591 arm and 17 patients in the ketoconazole monotherapy arm (2:1 allocation), this design will allow for the detection of a 30% absolute difference in the 18-month MFS proportion between the ketoconazole+J591 arm and the ketoconazole monotherapy arm (80% vs. 50%, respectively) with $\geq 80\%$ power and a one-sided alpha level of 10%. An additional 10% will be enrolled to account for loss to follow up (total projected number of subjects to be randomized = 55). A 95% CI for the difference in the 18-month MFS proportion between the two treatment arms can be constructed to be within $\pm 18\%$ of the true difference in 18-month MFS proportions.

13.1.1 ^{111}In -J591 as placebo

We have chosen to infuse ^{111}In -J591 as a placebo in this double-blind study. The infusion procedures and characteristics of this compound are similar to ^{177}Lu -J591. In addition, ^{111}In -J591 will allow imaging studies to be performed. Because ^{111}In is a pure gamma-emitter, there will be no treatment effect as in the beta emission with ^{177}Lu . It is theoretically possible that by infusing ^{111}In -J591, there will be a treatment effect by ADCC, thereby diluting the proportional effect of ^{177}Lu -J591 in the experimental arm. However, clinically meaningful ADCC is not expected, as it has been demonstrated at much higher doses of the J591 antibody (122), and by giving equal antibody doses in each study arm, we will be able to truly evaluate the effect of ^{177}Lu radioimmunotherapy.

13.2 Sample Size/Accrual Rate

The planned sample size is 55 subjects (50 + 10% for in-evaluable / loss to follow-up = 55). Subjects who come off protocol prior to day 29 of treatment (i.e. prior to infusion of study drug) will be replaced. It is anticipated that the average site will pre-screen several subjects per month and enroll approximately 3 subjects per year.

13.3 Stratification Factors

Patients will be stratified by treating institution and delivery of primary therapy (surgery and/or radiotherapy vs no primary therapy to the prostate).

13.4 Analysis of Secondary & Exploratory Endpoints

Secondary endpoints include biochemical (PSA) response rate, duration of PSA response, biochemical (PSA) progression, time to biochemical (PSA) progression, time to biochemical (PSA) progression above baseline, overall survival, and toxicity. We anticipate that the 95% confidence interval around the PSA response rate will be within $\pm 9\%$ of the true value for Arm 1 and within $\pm 15\%$ of the true value for Arm 2. Time to biochemical (PSA) progression, time to biochemical (PSA) progression above baseline, median MFS-time, and overall survival will be estimated using the Kaplan-Meier method, and 95% confidence intervals will be calculated using Greenwood's formula.

The frequency of subjects experiencing toxicities will be tabulated. Toxicities will be assessed and graded according to CTCAE v. 4.0 terminology. Exact 95% confidence intervals around the toxicity proportions will be calculated to assess the precision of the obtained estimates.

Imaging studies: The possibility of identifying sites of metastatic disease not apparent on conventional imaging (CT/MRI abdomen/pelvis, bone scan, and CXR) will be confirmed with serial imaging. Any potential metastatic site on J591 imaging will be followed over time by conventional imaging. Sites of disease appearing on J591 scan and subsequently confirmed by conventional imaging will be labeled as positive. Any site apparent on J591 scan that is subsequently biopsied as part of standard care and confirmed to be metastatic prostate cancer will be labeled as definite. Sites of disease appearing on J591 scan without any corroborating evidence (conventional imaging or biopsy) will be

labeled as possible.

Adrenal hormonal levels: Baseline adrenal hormonal levels will be categorized by median baseline levels found in CALGB 9583 (60, 61). In addition, as this may be a different patient population, we will analyze by median as well as quartiles. We will correlate levels with time to radiographic metastatic disease as well as PSA response and overall survival. Changes in adrenal hormone levels will be analyzed with time (baseline, 1 month, 6 months, at progression).

Plasma markers of hemostasis/fibrinolysis/angiogenesis: Baseline levels will be categorically analyzed by median as well as in quartiles and will be correlated with clinical endpoints (time to mets, survival, PSA response). We will also perform exploratory analyses using these values as continuous variables. In addition, a description of changes in levels of these markers with time/treatment will be reported. We will explore changes (decreases) by 50% (and median decrease) in correlation with outcome/response.

CTC's: Change in CTC counts will be summarized descriptively. Baseline counts ≥ 5 CTCs vs < 5 (per 7.5 mL) will be analyzed for time to metastatic disease in the overall population. We will also analyze changes with therapy: Decrease from ≥ 5 to < 5 , increase from < 5 to ≥ 5 , and stable categorical counts with respect to primary and secondary efficacy endpoints.

13.5 Reporting and Exclusions

13.5.1 Evaluation of toxicity. All patients will be evaluable for toxicity from the time of their first treatment on study. Toxicity of radiolabeled J591 in this population will be evaluated from the time of J591 administration.

13.5.2 Evaluation of response. All patients included in the study will be assessed for response to treatment if they have received at least 4 weeks of therapy with ketoconazole and received radiolabeled J591. Subjects dropping out of the study prior to J591 administration will be replaced.

14 Inclusion of Women and Minorities

Women are excluded from the protocol because prostate cancer is a disease of men. No exclusion based upon race/ethnicity will occur.

15. Study Personnel

Study Chair (Scott T. Tagawa, MD): Responsible for patient recruitment and over-all clinical management, protocol design and coordination, assessment of adverse events, safety, toxicity, and effect of treatment. Will communicate with principal investigators and study personnel at all sites and run monthly study teleconferences with the Study Coordinator. Will oversee any changes to the protocol and will be responsible for submitting amendments

to the appropriate regulatory agencies (such as IRB, DSMB, sponsors, FDA, etc.). [See also Appendix D]

WCMC Co-Investigators (David M. Nanus, MD, Caryn Ecker, NP, Himisha Beltran, MD, Yuliya Jhanwar, MD, Ana Molina, MD, Meghan Moran NP, Trisha Youn, MD): Responsible for patient recruitment, overall clinical management, assessment of adverse events, safety, toxicity, and effect of treatment. Will assist with protocol design, coordination, and interpretation of scans.

Nuclear Medicine Chairs (Stanley Goldsmith, MD, Shankar Vallabhajosula, PhD): Responsible for administration of IND agents (radiolabeled J591 antibodies) for diagnostic and therapeutic studies, will oversee evaluation and quantitation of radiolabeled J591 scans. Will oversee quality control of radiolabeled antibody.

Statistician (Paul Christos, MS, Dr.PH): Assist with study design, data analysis and interpretation, assist with protocol amendments.

Research Nurse Assist with patient recruitment, study drug administration, documentation of adverse events.

Study Coordinator Assist with pre-screening and screening of subjects at WCMC; communicate with DOD; coordinate potential and enrolled subjects at all sites; optimize accurate data collection and entry by communicating frequently with other sites; prepare data for analysis. Will run monthly study teleconferences with principal investigators and other study team members at other sites in conjunction with the Study Chair. Will assist the Study Chair in providing continuing review documents for appropriate regulatory agencies (such as IRB, DSMB, sponsors).

Research Monitor John Leonard, M.D. is responsible to oversee the safety of the research and report observations/findings to the IRB of Record or a designated official. The Research Monitor will review all unanticipated problems involving risk to volunteers or others associated with the protocol and provide an unbiased written report of the event to the IRB of Record. The Research Monitor may discuss the research protocol with the investigators, interview human subjects, and consult with others outside of the study about the research. The Research Monitor shall have authority to stop the research protocol in progress, remove individual human subjects from the study, and take whatever steps are necessary to protect the safety and well-being of human subjects until the IRB can assess the monitor's report. The Research Monitor is responsible for promptly reporting their observations and findings to the IRB. [See also Appendix D]

Consultant (Neil H. Bander, MD): Will provide insight and guidance in overall study design, use of antibody, and correlative studies examining PSMA expression. [see also Section 15.1]

15.1 Conflicts of Interest

Neil H. Bander, MD will serve as an unpaid consultant on the study. He holds the patent rights to J591 and has served as a paid consultant to BZL Biologics (company that has assisted in the production of the J591 monoclonal antibody). He will have no access to any of the study data other than the blinded material (circulating tumor cells and archived tissue slides) on which some of his lab personnel may perform PSMA staining. He will have no role in screening of subjects, obtaining informed consent, treatment of the subjects, or analysis and reporting of the data.

16. Funding

This protocol has been initiated with WCMC funding as well as funding via the WCMC CTSC. Funds from WCMC have been and will be supplemented through past grants from the Cancer Research Institute, the David H. Kock Foundation, and the National Cancer Institute. Part of the Study Chair's funding through a K12 mechanism (KL2 RR024997-01 (PI: Imperato-McGinley) K12 Clinical & Translational Research Training Scholars Award) and Prostate Cancer Foundation Young Investigator's award will cover his time and effort in the development of the protocol. The study will be performed at the WCMC CTSC through funds via the WCMC CTSA (UL1 RR024996). Additional study sites have preferentially been chosen because of available CTSA funding. Some of the correlative studies (adrenal androgen levels, plasma markers of hemostasis, fibrinolysis, and angiogenesis) will be performed in the WCMC CTSC core lab and will be funded via the CTSA. The user ID/password protected/encrypted web-based database will also be built and run by WCMC CTSC personnel funded via the CTSA.

Additional funding for the WCMC site will be obtained through the Department of Defense (via a DOD Prostate Cancer Research Program Clinical Trial Award (Funding Opportunity Number W81XWH-08-PCRP-CTA, PC081664). There will be strict non-overlapping budgets, as funds are available from multiple sources. Other sites will be funded via their CTSA and supplemented by the WCMC Urologic Oncology Research Fund.

17. Additional Study Sites

The study protocol has been developed by WCMC investigators. However, the Study Chair and other WCMC investigators have incorporated changes to the study design based upon input from a core group of investigators at additional sites provided via email, teleconferences, and an investigator meeting at the 2008 ASCO Annual Meeting. The core group of study investigators who provided input on study design will be included in initial safety review.

The below additional study sites (and principal investigators) are collaborators on this study protocol:

University of Southern California (David Quinn)
Indiana University (Costantine Albany)
University of Iowa (Dan Vaena)
Emory University (Omer Kucuk, David Schuster)
University of Pittsburgh (Leonard Appleman)
Cedars Sinai (Edwin Posadas)
University of Utah (Neeraj Agarwal)
Georgetown University (George Phillips)
University of Kansas (Peter Van Veldhuizen)
University of Arizona (Parminder Singh)
UF Health – Orlando (Julio Hajdenberg)

REFERENCES

1. Jemal A, Siegel R, Ward E, Murray T, Xu J, Thun MJ. Cancer statistics, 2007. *CA Cancer J Clin*. 2007 Jan-Feb;57(1):43-66.
2. Albertsen PC, Hanley JA, Gleason DF, Barry MJ. Competing risk analysis of men aged 55 to 74 years at diagnosis managed conservatively for clinically localized prostate cancer. *JAMA*. 1998 Sep 16;280(11):975-80.
3. Albertsen PC, Hanley JA, Fine J. 20-year outcomes following conservative management of clinically localized prostate cancer. *JAMA*. 2005 May 4;293(17):2095-101.
4. Scher HI, Leibel SA, Fuks Z, Cordon-Cardo C, Scardino PT. *Cancers of the Prostate* In: DeVita, Vincent T., Jr., Hellman S, Rosenberg SA, editors. 7th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2005;
5. Scher HI, Eisenberger M, D'Amico AV, Halabi S, Small EJ, Morris M, Kattan MW, Roach M, Kantoff P, Pienta KJ, Carducci MA, Agus D, Slovin SF, Heller G, Kelly WK, Lange PH, Petrylak D, Berg W, Higano C, Wilding G, Moul JW, Partin AN, Logothetis C, Soule HR. Eligibility and outcomes reporting guidelines for clinical trials for patients in the state of a rising prostate-specific antigen: Recommendations from the prostate-specific antigen working group. *J Clin Oncol*. 2004 Feb 1;22(3):537-56.
6. Freedland SJ, Moul JW. Prostate specific antigen recurrence after definitive therapy. *J Urol*. 2007 Jun;177(6):1985-91.
7. Pazona JF, Han M, Hawkins SA, Roehl KA, Catalona WJ. Salvage radiation therapy for prostate specific antigen progression following radical prostatectomy: 10-year outcome estimates. *J Urol*. 2005 Oct;174(4 Pt 1):1282-6.
8. Buskirk SJ, Pisansky TM, Schild SE, Macdonald OK, Wehle MJ, Kozelsky TF, Collie AC, Ferrigni RG, Myers RP, Prussak KA, Heckman MG, Crook JE, Parker AS, Igel TC. Salvage radiotherapy for isolated prostate specific antigen increase after radical prostatectomy: Evaluation of prognostic factors and creation of a prognostic scoring system. *J Urol*. 2006 Sep;176(3):985-90.
9. Stephenson AJ, Shariat SF, Zelefsky MJ, Kattan MW, Butler EB, Teh BS, Klein EA, Kupelian PA, Roehrborn CG, Pistenmaa DA, Pacholke HD, Liauw SL, Katz MS, Leibel SA, Scardino PT, Slawin KM. Salvage radiotherapy for recurrent prostate cancer after radical prostatectomy. *JAMA*. 2004 Mar 17;291(11):1325-32.
10. Ward JF, Zincke H, Bergstralh EJ, Slezak JM, Blute ML. Prostate specific antigen doubling time subsequent to radical prostatectomy as a prognosticator of outcome following salvage radiotherapy. *J Urol*. 2004 Dec;172(6 Pt 1):2244-8.
11. Kaminski M, Estes J, Zasadny K, Francis I, Ross C, Tuck M, Regan D, Fisher S, Gutierrez J, Kroll S, Stagg R, Tidmarsh G, Wahl R. Radioimmunotherapy with iodine 131I tositumomab for relapsed or refractory B-cell non-hodgkin lymphoma: Updated results and long-term follow-up of the university of michigan experience. *Blood*. 2000 August 15;96(4):1259-66.
12. Kaminski MS, Zelenetz AD, Press OW, Saleh M, Leonard J, Fehrenbacher L, Lister TA, Stagg RJ, Tidmarsh GF, Kroll S, Wahl RL, Knox SJ, Vose JM. Pivotal study of iodine I 131 tositumomab for chemotherapy-refractory low-grade or transformed low-grade B-cell non-hodgkin's lymphomas. *J Clin Oncol*. 2001 Oct 1;19(19):3918-28.
13. Press OW, Unger JM, Brazier RM, Maloney DG, Miller TP, LeBlanc M, Gaynor ER, Rivkin SE, Fisher RI. A phase 2 trial of CHOP chemotherapy followed by tositumomab/iodine I 131 tositumomab for previously untreated follicular non-hodgkin lymphoma: Southwest oncology group protocol S9911. *Blood*. 2003 Sep 1;102(5):1606-12.
14. Kaminski MS, Tuck M, Estes J, Kolstad A, Ross CW, Zasadny K, Regan D, Kison P, Fisher S, Kroll S, Wahl RL. 131I-tositumomab therapy as initial treatment for follicular lymphoma. *N Engl J Med*. 2005 Feb 3;352(5):441-9.
15. Leonard JP, Coleman M, Kostakoglu L, Chadburn A, Cesarman E, Furman RR, Schuster MW, Niesvizky R, Muss D, Fiore J, Kroll S, Tidmarsh G, Vallabhajosula S, Goldsmith SJ. Abbreviated chemotherapy with fludarabine followed by tositumomab and iodine I 131 tositumomab for untreated follicular lymphoma. *J Clin Oncol*. 2005 Aug 20;23(24):5696-704.
16. Press OW, Unger JM, Brazier RM, Maloney DG, Miller TP, Leblanc M, Fisher RI, Southwest Oncology Group. Phase II trial of CHOP chemotherapy followed by tositumomab/iodine I-131 tositumomab for previously untreated follicular non-hodgkin's lymphoma: Five-year follow-up of southwest oncology group protocol S9911. *J Clin Oncol*. 2006 Sep 1;24(25):4143-9.
17. Horoszewicz JS, Kawinski E, Murphy GP. Monoclonal antibodies to a new antigenic marker in epithelial prostatic cells and serum of prostatic cancer patients. *Anticancer Res*. 1987 Sep-Oct;7(5B):927-35.

18. Israeli RS, Powell CT, Fair WR, Heston WD. Molecular cloning of a complementary DNA encoding a prostate-specific membrane antigen. *Cancer Res.* 1993 Jan 15;53(2):227-30.
19. Israeli RS, Powell CT, Corr JG, Fair WR, Heston WD. Expression of the prostate-specific membrane antigen. *Cancer Res.* 1994 Apr 1;54(7):1807-11.
20. Wright GL, Haley C, Beckett ML, Schellhammer PF. Expression of prostate-specific membrane antigen in normal, benign, and malignant prostate tissues. *Urologic Oncology: Seminars and Original Investigations.* 1995/0;1(1):18-28.
21. Troyer JK, Beckett ML, Wright GL, Jr. Detection and characterization of the prostate-specific membrane antigen (PSMA) in tissue extracts and body fluids. *Int J Cancer.* 1995 Sep 4;62(5):552-8.
22. Sokoloff RL, Norton KC, Gasior CL, Marker KM, Grauer LS. A dual-monoclonal sandwich assay for prostate-specific membrane antigen: Levels in tissues, seminal fluid and urine. *Prostate.* 2000 May 1;43(2):150-7.
23. Bostwick DG, Pacelli A, Blute M, Roche P, Murphy GP. Prostate specific membrane antigen expression in prostatic intraepithelial neoplasia and adenocarcinoma: A study of 184 cases. *Cancer.* 1998 Jun 1;82(11):2256-61.
24. Wright GL, Jr, Grob BM, Haley C, Grossman K, Newhall K, Petrylak D, Troyer J, Konchuba A, Schellhammer PF, Moriarty R. Upregulation of prostate-specific membrane antigen after androgen-deprivation therapy. *Urology.* 1996 Aug;48(2):326-34.
25. Sweat SD, Pacelli A, Murphy GP, Bostwick DG. Prostate-specific membrane antigen expression is greatest in prostate adenocarcinoma and lymph node metastases. *Urology.* 1998 Oct;52(4):637-40.
26. Pinto, J T Suffoletto, B P Berzin, T M Qiao, C H Lin, S Tong, W P May, F Mukherjee, B Heston, W D. Prostate-specific membrane antigen: a novel folate hydrolase in human prostatic carcinoma cells. Denville, NJ: Association for Cancer Research; 1996. 1445 p.
27. Bander NH, Nanus DM, Milowsky MI, Kostakoglu L, Vallabhaajosula S, Goldsmith SJ. Targeted systemic therapy of prostate cancer with a monoclonal antibody to prostate-specific membrane antigen. *Semin Oncol.* 2003 Oct;30(5):667-76.
28. Kahn D, Williams RD, Manyak MJ, Haseman MK, Seldin DW, Libertino JA, Maguire RT. 111Indium-capromab pendetide in the evaluation of patients with residual or recurrent prostate cancer after radical prostatectomy. the ProstaScint study group. *J Urol.* 1998 discussion 2046-7; Jun;159(6):2041-6.
29. Kahn D, Williams RD, Haseman MK, Reed NL, Miller SJ, Gerstbrein J. Radioimmunoscinigraphy with in-111-labeled capromab pendetide predicts prostate cancer response to salvage radiotherapy after failed radical prostatectomy. *J Clin Oncol.* 1998 Jan;16(1):284-9.
30. Kahn D, Austin JC, Maguire RT, Miller SJ, Gerstbrein J, Williams RD. A phase II study of [90Y] yttrium-capromab pendetide in the treatment of men with prostate cancer recurrence following radical prostatectomy. *Cancer Biother Radiopharm.* 1999 Apr;14(2):99-111.
31. Deb N, Goris M, Trisler K, Fowler S, Saal J, Ning S, Becker M, Marquez C, Knox S. Treatment of hormone-refractory prostate cancer with 90Y-CYT-356 monoclonal antibody. *Clin Cancer Res.* 1996 Aug;2(8):1289-97.
32. Troyer JK, Feng Q, Beckett ML, Wright GL. Biochemical characterization and mapping of the 7E11-C5.3 epitope of the prostate-specific membrane antigen. *Urologic Oncology: Seminars and Original Investigations.* 1995/0;1(1):29-37.
33. Troyer JK, Beckett ML, Wright GL, Jr. Location of prostate-specific membrane antigen in the LNCaP prostate carcinoma cell line. *Prostate.* 1997 Mar 1;30(4):232-42.
34. Liu H, Moy P, Kim S, Xia Y, Rajasekaran A, Navarro V, Knudsen B, Bander NH. Monoclonal antibodies to the extracellular domain of prostate-specific membrane antigen also react with tumor vascular endothelium. *Cancer Res.* 1997 Sep 1;57(17):3629-34.
35. Yao D, Trabulsi EJ, Kostakoglu L, Vallabhaajosula S, Joyce MA, Nanus DM, Milowsky M, Liu H, Goldsmith SJ. The utility of monoclonal antibodies in the imaging of prostate cancer. *Semin Urol Oncol.* 2002 Aug;20(3):211-8.
36. Liu H, Rajasekaran AK, Moy P, Xia Y, Kim S, Navarro V, Rahmati R, Bander NH. Constitutive and antibody-induced internalization of prostate-specific membrane antigen. *Cancer Res.* 1998 Sep 15;58(18):4055-60.
37. McDevitt, M R Barendswaard, E Ma, D Lai, L Curcio, M J Sgouros, G Ballangrud, A M Yang, W H Finn, R D Pellegrini, V Geerlings, M W Lee, M Brechbiel, M W Bander, N H Cordon-Cardo, C Scheinberg, D A. An alpha-particle emitting antibody ([213Bi]J591) for radioimmunotherapy of prostate cancer. Baltimore, Md.: Waverly Press; 2000. 6095 p.

38. Smith-Jones PM, Vallabahajosula S, Goldsmith SJ, Navarro V, Hunter CJ, Bastidas D, Bander NH. In vitro characterization of radiolabeled monoclonal antibodies specific for the extracellular domain of prostate-specific membrane antigen. *Cancer Res.* 2000 Sep 15;60(18):5237-43.
39. Smith-Jones PM, Vallabahajosula S, Navarro V, Bastidas D, Goldsmith SJ, Bander NH. Radiolabeled monoclonal antibodies specific to the extracellular domain of prostate-specific membrane antigen: Preclinical studies in nude mice bearing LNCaP human prostate tumor. *J Nucl Med.* 2003 Apr;44(4):610-7.
40. Adams, G P Schier, R McCall, A M Simmons, H H Horak, E M Alpaugh, R K Marks, J D Weiner, L M. High affinity restricts the localization and tumor penetration of single-chain fv antibody molecules. Baltimore, Md.: Waverly Press; 2001. 4750 p.
41. Bander NH, Nanus D, Bremer S, Smith-Jones P, Kostakoglu L, Vallabahajosula S, Goldsmith S, Liu H, Moy P, Xia J, Kim S, Navarro V. Phase I Clinical Trial Targeting a Monoclonal Antibody (mAb) to the Extracellular Domain of Prostate Specific Membrane Antigen (PSMAext) in Patients with Hormone-Independent Prostate Cancer. ; 2000. (Abstr 1872) p.
42. Bander NH, Nanus D, Goldstein S, Kostakoglu L, Kuji I, Smith-Jones P, Vallabahajosula S, Joyce M, Xia J, Kim S. Phase I Trial of Humanized Monoclonal Antibody (mAb) to Prostate Specific Membrane Antigen/Extracellular Domain (PSMAext). ; 2001. (Abst 722) p.
43. Vallabahajosula S, Goldsmith SJ, Hamacher KA, Kostakoglu L, Konishi S, Milowski MI, Nanus DM, Bander NH. Prediction of myelotoxicity based on bone marrow radiation-absorbed dose: Radioimmunotherapy studies using 90Y- and 177Lu-labeled J591 antibodies specific for prostate-specific membrane antigen. *J Nucl Med.* 2005 May;46(5):850-8.
44. Vallabahajosula S, Goldsmith SJ, Kostakoglu L, Milowsky MI, Nanus DM, Bander NH. Radioimmunotherapy of prostate cancer using 90Y- and 177Lu-labeled J591 monoclonal antibodies: Effect of multiple treatments on myelotoxicity. *Clin Cancer Res.* 2005 Oct 1;11(19 Pt 2):7195s-200s.
45. Vallabahajosula S, Kuji I, Hamacher KA, Konishi S, Kostakoglu L, Kothari PA, Milowski MI, Nanus DM, Bander NH, Goldsmith SJ. Pharmacokinetics and biodistribution of 111In- and 177Lu-labeled J591 antibody specific for prostate-specific membrane antigen: Prediction of 90Y-J591 radiation dosimetry based on 111In or 177Lu? *J Nucl Med.* 2005 Apr;46(4):634-41.
46. Milowsky MI, Nanus DM, Kostakoglu L, Vallabahajosula S, Goldsmith SJ, Bander NH. Phase I trial of yttrium-90-labeled anti-prostate-specific membrane antigen monoclonal antibody J591 for androgen-independent prostate cancer.see comment. *J Clin Oncol.* 2004 Jul 1;22(13):2522-31.
47. Bander NH, Milowsky MI, Nanus DM, Kostakoglu L, Vallabahajosula S, Goldsmith SJ. Phase I trial of 177lutetium-labeled J591, a monoclonal antibody to prostate-specific membrane antigen, in patients with androgen-independent prostate cancer. *J Clin Oncol.* 2005 Jul 20;23(21):4591-601.
48. Henry, Michael D Wen, Shenghua Silva, Matthew D Chandra, Sudeep Milton, Mark Worland, Peter J. A prostate-specific membrane antigen-targeted monoclonal antibody-chemotherapeutic conjugate designed for the treatment of prostate cancer. Baltimore, Md.: Waverly Press; 2004. 7995 p.
49. Galsky M, Eisenberger M, Moore-Cooper S, Kelly WK, Slovin S, Owens L, Delacruz A, Curley T, Webb IJ, Scher HI. First in man study of the prostate specific membrane antigen targeted immunoconjugate, MLN2704, in patients with progressive castrate metastatic prostate cancer (PCMPC): Updated results. In:
50. Milowski MI, Galsky M, George DJ, Lewin JM, Rozario CP, Marshall T, Chang M, Nanus DM, Webb IJ, Scher HI. Phase I/II trial of the prostate-specific membrane antigen (PSMA)-targeted immunoconjugate MLN2704 in patients (pts) with progressive metastatic castration resistant prostate cancer (CRPC). ; 2006. 4500 p.
51. Tagawa ST, Milowsky MI, Morris M, Vallabahajosula S, Goldsmith S, Matulich D, Kaplan J, Berger F, Scher HI, Bander NH, Nanus DM. Phase II trial of 177Lutetium radiolabeled anti-prostate-specific membrane antigen (PSMA) monoclonal antibody J591 (177Lu-J591) in patients (pts) with metastatic castrate-resistant prostate cancer (metCRPC). In: Proceedings of the Annual Meeting of the American Society of Clinical Oncologists ; 2008; Chicago, IL. 2008. p. 284s (Abst 5140).
52. Petrylak DP, Ankerst DP, Jiang CS, Tangen CM, Hussain MH, Lara PN, Jr, Jones JA, Taplin ME, Burch PA, Kohli M, Benson MC, Small EJ, Raghavan D, Crawford ED. Evaluation of prostate-specific antigen declines for surrogacy in patients treated on SWOG 99-16. *J Natl Cancer Inst.* 2006 Apr 19;98(8):516-21.
53. Armstrong AJ, Garrett-Mayer E, Ou Yang YC, Carducci MA, Tannock I, de Wit R, Eisenberger M. Prostate-specific antigen and pain surrogacy analysis in metastatic hormone-refractory prostate cancer. *J Clin Oncol.* 2007 Sep 1;25(25):3965-70.
54. Langmuir VK. Radiobiology of radiolabeled antibody therapy as applied to tumor dosimetry. *Medical physics.* 1993;20(2 Pt 2):601.

55. Leichner PK, Akabani G, Colcher D, Harrison KA, Hawkins WG, Eckblade M, Baranowska-Kortylewicz J, Augustine SC, Wisecarver J, Tempero MA. Patient-specific dosimetry of indium-111- and yttrium-90-labeled monoclonal antibody CC49. *J Nucl Med.* 1997;38(4):512-6.
56. DeNardo SJ, Kramer EL, O'Donnell RT, Richman CM, Salako QA, Shen S, Noz M, Glenn SD, Ceriani RL, DeNardo GL. Radioimmunotherapy for breast cancer using indium-111/yttrium-90 BrE-3: Results of a phase I clinical trial. *J Nucl Med.* 1997;38(8):1180-5.
57. Labrie F, Belanger A, Simard J, Labrie C, Dupont A. Combination therapy for prostate cancer. endocrine and biologic basis of its choice as new standard first-line therapy. *Cancer.* 1993;71(3 Suppl):1059-67.
58. Brendler H. Adrenalectomy and hypophysectomy for prostatic cancer. *Urology.* 1973;2(2):99-102.
59. Sartor O, Cooper M, Weinberger M, Headlee D, Thibault A, Tompkins A, Steinberg S, Figg W, Linehan WM, Myers C. Surprising activity of flutamide withdrawal, when combined with aminoglutethimide, in treatment of "hormone-refractory" prostate cancer. *J Natl Cancer Inst.* 1994 February 2;86(3):222-7.
60. Small EJ, Halabi S, Dawson NA, Stadler WM, Rini BI, Picus J, Gable P, Torti FM, Kaplan E, Vogelzang NJ. Antiandrogen withdrawal alone or in combination with ketoconazole in androgen-independent prostate cancer patients: A phase III trial (CALGB 9583). *J Clin Oncol.* 2004 Mar 15;22(6):1025-33.
61. Ryan CJ, Halabi S, Ou SS, Vogelzang NJ, Kantoff P, Small EJ. Adrenal androgen levels as predictors of outcome in prostate cancer patients treated with ketoconazole plus antiandrogen withdrawal: Results from a cancer and leukemia group B study. *Clin Cancer Res.* 2007 Apr 1;13(7):2030-7.
62. Trousseau A. Phlegmasia alba dolens In: *Clinique Medicale de l'Hotel-Dieu.* Paris: JB Balliere et Fils; 1865; p. 3: 654-712.
63. Blom JW, Doggen CJ, Osanto S, Rosendaal FR. Malignancies, prothrombotic mutations, and the risk of venous thrombosis. *JAMA.* 2005 Feb 9;293(6):715-22.
64. Levitan N, Dowlati A, Remick SC, Tahsildar HI, Sivinski LD, Beyth R, Rimm AA. Rates of initial and recurrent thromboembolic disease among patients with malignancy versus those without malignancy. risk analysis using medicare claims data. *Medicine (Baltimore).* 1999 Sep;78(5):285-91.
65. Prandoni P, Lensing AW, Piccioli A, Bernardi E, Simioni P, Girolami B, Marchiori A, Sabbion P, Prins MH, Noventa F, Girolami A. Recurrent venous thromboembolism and bleeding complications during anticoagulant treatment in patients with cancer and venous thrombosis. *Blood.* 2002 Nov 15;100(10):3484-8.
66. Sorensen HT, Mellekjaer L, Olsen JH, Baron JA. Prognosis of cancers associated with venous thromboembolism. *N Engl J Med.* 2000 Dec 21;343(25):1846-50.
67. Rickles FR, Levine M, Edwards RL. Hemostatic alterations in cancer patients. *Cancer Metastasis Rev.* 1992 Nov;11(3-4):237-48.
68. Rickles FR, Patierno SR, Fernandez PM. Targeting the endothelium in cancer--the importance of the interaction of hemostatic mechanisms and the vascular wall for tumor growth and angiogenesis. *Pathophysiol Haemost Thromb.* 2003;33 Suppl 1:1-4.
69. Donati MB, Lorenzet R. Coagulation factors and tumor cell biology: The role of tissue factor. *Pathophysiol Haemost Thromb.* 2003;33 Suppl 1:22-5.
70. Taguchi O, Gabazza EC, Yasui H, Kobayashi T, Yoshida M, Kobayashi H. Prognostic significance of plasma D-dimer levels in patients with lung cancer. *Thorax.* 1997 Jun;52(6):563-5.
71. Buccheri G, Ferrigno D, Ginardi C, Zuliani C. Haemostatic abnormalities in lung cancer: Prognostic implications. *Eur J Cancer.* 1997 Jan;33(1):50-5.
72. Buccheri G, Torchio P, Ferrigno D. Plasma levels of D-dimer in lung carcinoma: Clinical and prognostic significance. *Cancer.* 2003 Jun 15;97(12):3044-52.
73. Blackwell K, Haroon Z, Broadwater G, Berry D, Harris L, Iglehart JD, Dewhirst M, Greenberg C. Plasma D-dimer levels in operable breast cancer patients correlate with clinical stage and axillary lymph node status. *J Clin Oncol.* 2000 Feb;18(3):600-8.
74. Dirix LY, Salgado R, Weytjens R, Colpaert C, Benoy I, Huget P, van Dam P, Prove A, Lemmens J, Vermeulen P. Plasma fibrin D-dimer levels correlate with tumour volume, progression rate and survival in patients with metastatic breast cancer. *Br J Cancer.* 2002 Feb 1;86(3):389-95.
75. Oya M, Akiyama Y, Okuyama T, Ishikawa H. High preoperative plasma D-dimer level is associated with advanced tumor stage and short survival after curative resection in patients with colorectal cancer. *Jpn J Clin Oncol.* 2001 Aug;31(8):388-94.
76. von Tempelhoff GF, Dietrich M, Niemann F, Schneider D, Hommel G, Heilmann L. Blood coagulation and thrombosis in patients with ovarian malignancy. *Thromb Haemost.* 1997 Mar;77(3):456-61.
77. Falanga A, Ofosu FA, Cortelazzo S, Delaini F, Consonni R, Caccia R, Longatti S, Maran D, Rodeghiero F, Pogliani E. Preliminary study to identify cancer patients at high risk of venous thrombosis following major

- surgery. *Br J Haematol*. 1993 Dec;85(4):745-50.
78. Seitz R, Heidtmann HH, Wolf M, Immel A, Egbring R. Prognostic impact of an activation of coagulation in lung cancer. *Ann Oncol*. 1997 Aug;8(8):781-4.
79. Francis JL, Amirkhosravi A. Effect of antihemostatic agents on experimental tumor dissemination. *Semin Thromb Hemost*. 2002 Feb;28(1):29-38.
80. Cosgrove RH, Zacharski LR, Racine E, Andersen JC. Improved cancer mortality with low-molecular-weight heparin treatment: A review of the evidence. *Semin Thromb Hemost*. 2002 Feb;28(1):79-87.
81. Kakkar AK. An expanding role for antithrombotic therapy in cancer patients. *Cancer Treat Rev*. 2003 Jun;29 Suppl 2:23-6.
82. Smorenburg SM, Van Noorden CJ. The complex effects of heparins on cancer progression and metastasis in experimental studies. *Pharmacol Rev*. 2001 Mar;53(1):93-105.
83. Kohli M, Kaushal V, Mehta P. Role of coagulation and fibrinolytic system in prostate cancer. *Semin Thromb Hemost*. 2003 Jun;29(3):301-8.
84. Tagnon HJ, Whitmore WF, Jr, Schulman P, Kravitz SC. The significance of fibrinolysis occurring in patients with metastatic cancer of the prostate. *Cancer*. 1953 Jan;6(1):63-7.
85. Kohli M, Fink LM, Spencer HJ, Zent CS. Advanced prostate cancer activates coagulation: A controlled study of activation markers of coagulation in ambulatory patients with localized and advanced prostate cancer. *Blood Coagul Fibrinolysis*. 2002 Jan;13(1):1-5.
86. Abdulkadir SA, Carvalhal GF, Kaleem Z, Kisiel W, Humphrey PA, Catalona WJ, Milbrandt J. Tissue factor expression and angiogenesis in human prostate carcinoma. *Hum Pathol*. 2000 Apr;31(4):443-7.
87. Akashi T, Furuya Y, Ohta S, Fuse H. Tissue factor expression and prognosis in patients with metastatic prostate cancer. *Urology*. 2003 Dec;62(6):1078-82.
88. Shariat SF, Andrews B, Kattan MW, Kim J, Wheeler TM, Slawin KM. Plasma levels of interleukin-6 and its soluble receptor are associated with prostate cancer progression and metastasis. *Urology*. 2001 Dec;58(6):1008-15.
89. Kattan MW, Shariat SF, Andrews B, Zhu K, Canto E, Matsumoto K, Muramoto M, Scardino PT, Ohori M, Wheeler TM, Slawin KM. The addition of interleukin-6 soluble receptor and transforming growth factor beta1 improves a preoperative nomogram for predicting biochemical progression in patients with clinically localized prostate cancer. *J Clin Oncol*. 2003 Oct 1;21(19):3573-9.
90. Kuniyasu H, Troncso P, Johnston D, Bucana CD, Tahara E, Fidler IJ, Pettaway CA. Relative expression of type IV collagenase, E-cadherin, and vascular endothelial growth factor/vascular permeability factor in prostatectomy specimens distinguishes organ-confined from pathologically advanced prostate cancers. *Clin Cancer Res*. 2000 Jun;6(6):2295-308.
91. Schneider S, Park DJ, Yang D, El-Khoueiry A, Sherrod A, Groshen S, Streeter O, Iqbal S, Danenberg KD, Lenz HJ. Gene expression in tumor-adjacent normal tissue is associated with recurrence in patients with rectal cancer treated with adjuvant chemoradiation. *Pharmacogenet Genomics*. 2006 Aug;16(8):555-63.
92. Zeng Y, Opeskin K, Baldwin ME, Horvath LG, Achen MG, Stacker SA, Sutherland RL, Williams ED. Expression of vascular endothelial growth factor receptor-3 by lymphatic endothelial cells is associated with lymph node metastasis in prostate cancer. *Clin Cancer Res*. 2004 Aug 1;10(15):5137-44.
93. Mazzucchelli R, Montironi R, Santinelli A, Lucarini G, Pignatelli A, Biagini G. Vascular endothelial growth factor expression and capillary architecture in high-grade PIN and prostate cancer in untreated and androgen-ablated patients. *Prostate*. 2000 Sep 15;45(1):72-9.
94. Tagawa ST, Dorff TB, Rochanda L, Ye W, Hannoun D, Eiseler N, Lieskovsky G, Skinner DG, Liebman HA, Quinn DI. Subclinical hemostatic activation and surgical volume predict peri-operative bleeding with radical prostatectomy. *J Clin Oncol*. 2007;25(18S):2007 ASCO Annual Meeting Proceedings Part 1: Abst 5136.
95. Tagawa ST, Dorff TB, Rochanda L, Ye W, Boyle S, Lieskovsky G, Skinner DG, Raghavan D, Liebman HA, Quinn DI. Hemostatic activation, fibrinolysis, and angiogenesis prior to radical prostatectomy: Prediction of bleeding and prognosis. ; February, 2007.
96. Stephenson AJ, Scardino PT, Eastham JA, Bianco FJ, Jr, Dotan ZA, DiBlasio CJ, Reuther A, Klein EA, Kattan MW. Postoperative nomogram predicting the 10-year probability of prostate cancer recurrence after radical prostatectomy. *J Clin Oncol*. 2005 Oct 1;23(28):7005-12.
97. Racila E, Euhus D, Weiss AJ, Rao C, McConnell J, Terstappen LW, Uhr JW. Detection and characterization of carcinoma cells in the blood. *Proc Natl Acad Sci U S A*. 1998 Apr 14;95(8):4589-94.
98. Allard WJ, Matera J, Miller MC, Repollet M, Connelly MC, Rao C, Tibbe AG, Uhr JW, Terstappen LW. Tumor cells circulate in the peripheral blood of all major carcinomas but not in healthy subjects or patients with nonmalignant diseases. *Clin Cancer Res*. 2004 Oct 15;10(20):6897-904.

99. Momburg F, Moldenhauer G, Hammerling GJ, Moller P. Immunohistochemical study of the expression of a mr 34,000 human epithelium-specific surface glycoprotein in normal and malignant tissues. *Cancer Res.* 1987 Jun 1;47(11):2883-91.
100. Osta WA, Chen Y, Mikhitarian K, Mitas M, Salem M, Hannun YA, Cole DJ, Gillanders WE. EpCAM is overexpressed in breast cancer and is a potential target for breast cancer gene therapy. *Cancer Res.* 2004 Aug 15;64(16):5818-24.
101. Litvinov SV, Velders MP, Bakker HA, Fleuren GJ, Warnaar SO. Ep-CAM: A human epithelial antigen is a homophilic cell-cell adhesion molecule. *J Cell Biol.* 1994 Apr;125(2):437-46.
102. Paterlini-Brechot P, Benali NL. Circulating tumor cells (CTC) detection: Clinical impact and future directions. *Cancer Lett.* 2007 Aug 18;253(2):180-204.
103. Cristofanilli M, Budd GT, Ellis MJ, Stopeck A, Matera J, Miller MC, Reuben JM, Doyle GV, Allard WJ, Terstappen LW, Hayes DF. Circulating tumor cells, disease progression, and survival in metastatic breast cancer. *N Engl J Med.* 2004 Aug 19;351(8):781-91.
104. Cristofanilli M, Hayes DF, Budd GT, Ellis MJ, Stopeck A, Reuben JM, Doyle GV, Matera J, Allard WJ, Miller MC, Fritsche HA, Hortobagyi GN, Terstappen LW. Circulating tumor cells: A novel prognostic factor for newly diagnosed metastatic breast cancer. *J Clin Oncol.* 2005 Mar 1;23(7):1420-30.
105. Moreno JG, Miller MC, Gross S, Allard WJ, Gomella LG, Terstappen LW. Circulating tumor cells predict survival in patients with metastatic prostate cancer. *Urology.* 2005 Apr;65(4):713-8.
106. Danila DC, Heller G, Gignac GA, Gonzalez-Espinoza R, Anand A, Tanaka E, Lilja H, Schwartz L, Larson S, Fleisher M, Scher HI. Circulating tumor cell number and prognosis in progressive castration-resistant prostate cancer. *Clin Cancer Res.* 2007 Dec 1;13(23):7053-8.
107. Shaffer DR, Leversha MA, Danila DC, Lin O, Gonzalez-Espinoza R, Gu B, Anand A, Smith K, Maslak P, Doyle GV, Terstappen LW, Lilja H, Heller G, Fleisher M, Scher HI. Circulating tumor cell analysis in patients with progressive castration-resistant prostate cancer. *Clin Cancer Res.* 2007 Apr 1;13(7):2023-9.
108. Schiffer CA, Anderson KC, Bennett CL, Bernstein S, Elting LS, Goldsmith M, Goldstein M, Hume H, McCullough JJ, McIntyre RE, Powell BL, Rainey JM, Rowley SD, Rebutta P, Troner MB, Wagnon AH, American Society of Clinical Oncology. Platelet transfusion for patients with cancer: Clinical practice guidelines of the american society of clinical oncology. *J Clin Oncol.* 2001 Mar 1;19(5):1519-38.
109. Smith TJ, Khatcheressian J, Lyman GH, Ozer H, Armitage JO, Balducci L, Bennett CL, Cantor SB, Crawford J, Cross SJ, Demetri G, Desch CE, Pizzo PA, Schiffer CA, Schwartzberg L, Somerfield MR, Somlo G, Wade JC, Wade JL, Winn RJ, Wozniak AJ, Wolff AC. 2006 update of recommendations for the use of white blood cell growth factors: An evidence-based clinical practice guideline. *J Clin Oncol.* 2006 Jul 1;24(19):3187-205.
110. Small EJ, Reese DM, Um B, Whisenant S, Dixon SC, Figg WD. Therapy of advanced prostate cancer with granulocyte macrophage colony-stimulating factor. *Clin Cancer Res.* 1999 Jul;5(7):1738-44.
111. Dreicer R, See WA, Klein EA. Phase II trial of GM-CSF in advanced prostate cancer. *Invest New Drugs.* 2001;19(3):261-5.
112. Rini BI, Weinberg V, Bok R, Small EJ. Prostate-specific antigen kinetics as a measure of the biologic effect of granulocyte-macrophage colony-stimulating factor in patients with serologic progression of prostate cancer. *J Clin Oncol.* 2003 Jan 1;21(1):99-105.
113. Rini BI, Fong L, Weinberg V, Kavanaugh B, Small EJ. Clinical and immunological characteristics of patients with serologic progression of prostate cancer achieving long-term disease control with granulocyte-macrophage colony-stimulating factor. *J Urol.* 2006 Jun;175(6):2087-91.
114. Schwaab T, Tretter CP, Gibson JJ, Cole BF, Schned AR, Harris R, Fisher JL, Crosby N, Stempkowski LM, Heaney JA, Ernstoff MS. Tumor-related immunity in prostate cancer patients treated with human recombinant granulocyte monocyte-colony stimulating factor (GM-CSF). *Prostate.* 2006 May 1;66(6):667-74.
115. Ryan CJ, Weinberg V, Rosenberg J, Fong L, Lin A, Kim J, Small EJ. Phase II study of ketoconazole plus granulocyte-macrophage colony-stimulating factor for prostate cancer: Effect of extent of disease on outcome. *J Urol.* 2007 Dec;178(6):2372,6; discussion 2377.
116. Roboz GJ, Bennett JM, Coleman M, Ritchie EK, Furman RR, Rossi A, Jhaveri K, Feldman EJ, Leonard JP. Therapy-related myelodysplastic syndrome and acute myeloid leukemia following initial treatment with chemotherapy plus radioimmunotherapy for indolent non-hodgkin lymphoma. *Leuk Res.* 2007 Aug;31(8):1141-4.
117. Bennett JM, Kaminski MS, Leonard JP, Vose JM, Zelenetz AD, Knox SJ, Horning S, Press OW, Radford JA, Kroll SM, Capizzi RL. Assessment of treatment-related myelodysplastic syndromes and acute myeloid leukemia in patients with non-hodgkin lymphoma treated with tositumomab and iodine I131 tositumomab.

- Blood. 2005 Jun 15;105(12):4576-82.
118. Czuczman MS, Emmanouilides C, Darif M, Witzig TE, Gordon LI, Revell S, Vo K, Molina A. Treatment-related myelodysplastic syndrome and acute myelogenous leukemia in patients treated with ibritumomab tiuxetan radioimmunotherapy. *J Clin Oncol*. 2007 Sep 20;25(27):4285-92.
 119. Fleming MT, Morris MJ, Heller G, Scher HI. Post-therapy changes in PSA as an outcome measure in prostate cancer clinical trials. *Nat Clin Pract Oncol*. 2006 Dec;3(12):658-67.
 120. Scher HI, Kelly WM, Zhang ZF, Ouyang P, Sun M, Schwartz M, Ding C, Wang W, Horak ID, Kremer AB. Post-therapy serum prostate-specific antigen level and survival in patients with androgen-independent prostate cancer. *J Natl Cancer Inst*. 1999 Feb 3;91(3):244-51.
 121. O'Brien PC, Fleming TR. A multiple testing procedure for clinical trials. *Biometrics*. 1979 Sep;35(3):549-56.
 122. Morris MJ, Divgi CR, Pandit-Taskar N, Batraki M, Warren N, Nacca A, Smith-Jones P, Schwartz L, Kelly WK, Slovin S, Solit D, Halpern J, Delacruz A, Curley T, Finn R, O'donoghue JA, Livingston P, Larson S, Scher HI. Pilot trial of unlabeled and indium-111-labeled anti-prostate-specific membrane antigen antibody J591 for castrate metastatic prostate cancer. *Clin Cancer Res*. 2005 Oct 15;11(20):7454-61.

APPENDICES

- **Appendix A - Performance Status Criteria**
- **Appendix B – Stopping Rules from prior phase II study**
- **Appendix C - % Skeleton for Radiotherapy**
- **Appendix D – Department of Defense Information**
- **Appendix E – Radiographic guidelines**
- **Appendix F – Substitution for ketoconazole (selected countries outside of U.S.)**
- **Appendix G – Functional Assessment of Cancer Therapy – Prostate (FACT-P)**
- **Appendix H – PIRADS v2**

APPENDIX A

Performance Status Criteria

ECOG Performance Status Scale		Karnofsky Performance Scale	
Grade	Descriptions	Percent	Description
0	Normal activity. Fully active, able to carry on all pre-disease performance without restriction.	100	Normal, no complaints, no evidence of disease.
		90	Able to carry on normal activity; minor signs or symptoms of disease.
1	Symptoms, but ambulatory. Restricted in physically strenuous activity, but ambulatory and able to carry out work of a light or sedentary nature (e.g., light housework, office work).	80	Normal activity with effort; some signs or symptoms of disease.
		70	Cares for self, unable to carry on normal activity or to do active work.
2	In bed <50% of the time. Ambulatory and capable of all self-care, but unable to carry out any work activities. Up and about more than 50% of waking hours.	60	Requires occasional assistance, but is able to care for most of his/her needs.
		50	Requires considerable assistance and frequent medical care.
3	In bed >50% of the time. Capable of only limited self-care, confined to bed or chair more than 50% of waking hours.	40	Disabled, requires special care and assistance.
		30	Severely disabled, hospitalization indicated. Death not imminent.
4	100% bedridden. Completely disabled. Cannot carry on any self-care. Totally confined to bed or chair.	20	Very sick, hospitalization indicated. Death not imminent.
		10	Moribund, fatal processes progressing rapidly.
5	Dead.	0	Dead.

APPENDIX B

Stopping Rules (from phase 2 single-dose study, to be used as a guideline for DSMB reporting)

In the initial portion of the single-dose phase II study of ^{177}Lu -J591 for men with metastatic CRPC, the FDA required notification with a hold on further enrollment pending review if any of the below criteria were met. For the current study, the DSMB must be notified when any of the below stopping rules occur. Should >1 subject within the initial 9 experience any of the following, further enrollment will be held until DSMB review and FDA permission for continuation is given.

Hematologic

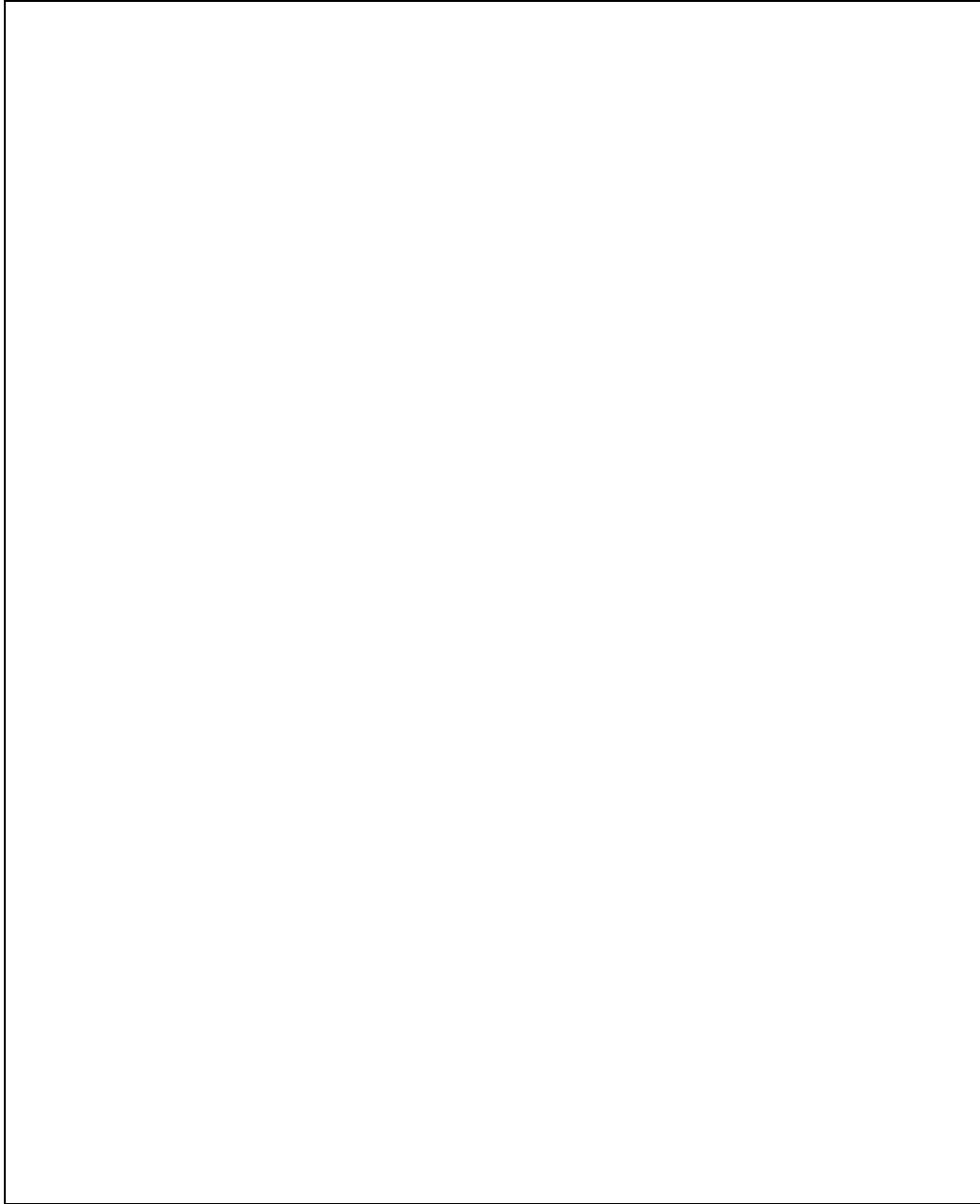
- Grade 4 thrombocytopenia that persists for ≥ 14 days after therapy
- Grade 4 thrombocytopenia that requires > 2 platelet transfusions over a 14 day period (note that multiple units of platelet products given together are considered a single transfusion)
- Grade 3 thrombocytopenia persisting > 30 days
- Grade 4 neutropenia that requires growth factor support for more than 14 days
- Grade 3 neutropenia that persists > 30 days
- Febrile neutropenia

Non-hematologic

- Any \geq Grade 3 non-hematologic toxicity considered by the investigator to be related to study drug (radiolabeled J591)

The NCI Common Toxicity Criteria for adverse events (CTCAE) version 4.0 will be utilized.

Appendix C Calculation of % Skeleton Involvement*



*International Commission on Radiological Protection: Task Group on Reference Man. Report of the task Group on Reference Man: a report prepared by a task group of Committee 2 of the International Commission on Radiological Protection. Oxford; New York: Pergamon Press, 1975

Appendix D

Protocol Addendum

A Randomized Phase 2 Trial of ^{177}Lu Radiolabeled Monoclonal Antibody HuJ591 (^{177}Lu -J591) and Ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy
IRB # 0810010067
HRPO Log Number A-15378

The following are reporting requirements and responsibilities of the Principal Investigator to the United States Army Medical Research and Materiel Command's (USAMRMC) Office of Research Protections (ORP), Human Research Protection Office (HRPO).

(1) The protocol will be conducted in accordance with the protocol submitted to and approved by the USAMRMC ORP HRPO and will not be initiated until written notification of approval of the research project is issued by the USAMRMC ORP HRPO.

(2) Accurate and complete study records will be maintained and made available to representatives of the U.S. Army Medical Research and Materiel Command as a part of their responsibility to protect human subjects in research. Research records will be stored in a manner so as to protect the confidentiality of subject information.

(3) All unanticipated problems involving risk to subjects or others, serious adverse events related to participation in the study and subject deaths related to participation in the study will be promptly reported by phone (301-619-2165), by email (hsrrb@amedd.army.mil), or by facsimile (301-619-7803) to the USAMRMC, Office of Research Protections, Human Research Protection Office. A complete written report will follow the initial notification. In addition to the methods above, the complete report will be sent to the U.S. Army Medical Research and Materiel Command, ATTN: MCMR-RP, 504 Scott Street, Fort Detrick, Maryland 21702-5012.

(4) Suspensions, clinical holds (voluntary or involuntary), or terminations of this research by the IRB, the institution, the Sponsor, or regulatory agencies will be promptly reported to the USAMRMC ORP HRPO.

(5) Any deviation to the protocol that may have an adverse effect on the safety or rights of the subject or the integrity of the study will be reported to the USAMRMC ORP HRPO as soon as the deviation is identified.

(6) Major modifications to the research protocol and any modifications that could potentially increase risk to subjects will be submitted to the USAMRMC ORP HRPO for approval prior to implementation. All other amendments will be submitted with the continuing review report to the USAMRMC ORP HRPO for acceptance.

(7) A copy of the approved continuing review report and the local IRB approval notification will be submitted to the USAMRMC ORP HRPO as soon as these documents become available. A copy of the approved final study report and local IRB approval notification will be submitted to the USAMRMC ORP HRPO as soon as these documents become available.

(8) The knowledge of any pending compliance inspection/visit by the FDA, OHRP, or other government agency concerning this clinical investigation or research, the issuance of Inspection Reports, FDA Form 483, warning letters or actions taken by any Regulatory Agencies including legal or medical actions and any instances of serious or continuing noncompliance with the regulations or requirements that relate to this clinical investigation or research will be reported immediately to USAMRMC ORP HRPO.

Guidance for the Requirement of a Medical Monitor

Per DoD Directive 3216.02, all greater than minimal risk studies require a Medical Monitor. The USAMRMC ORP HRPO also reserves the authority to require assignment of a Medical Monitor for those protocols assessed as presenting no greater than minimal risk to the subjects participating in the study.

Responsibilities of the Medical Monitor

The medical monitor is required to review all unanticipated problems involving risk to subjects or others, serious adverse events and all subject deaths associated with the protocol and provide an unbiased written report of the event. At a minimum, the medical monitor must comment on the outcomes of the event or problem and in case of a serious adverse event or death, comment on the relationship to participation in the study. The medical monitor must also indicate whether he/she concurs with the details of the report provided by the principal investigator. Reports for events determined by either the investigator or medical monitor to be possibly or definitely related to participation and reports of events resulting in death must be promptly forwarded to the USAMRMC ORP HRPO.

Please indicate the name of the medical monitor and the role they will have in this research study. This individual will be a qualified physician, other than the principal Investigator, not associated with this particular study, able to provide medical care to research subjects for conditions that may arise during the conduct of this study, and will monitor the subjects during the conduct of the study.

Research Monitor: John Leonard, MD

Describe the specific role of the Research Monitor in this research study:

The Research Monitor is responsible to oversee the safety of the research and report observations/findings to the IRB of Record or a designated official. The Research Monitor will review all unanticipated problems involving risk to volunteers or others associated with the protocol and provide an unbiased written report of the event to the IRB of Record. The Research Monitor may discuss the research protocol with the investigators, interview human subjects, and consult with others outside of the study about the research. The Research Monitor shall have authority to stop the research protocol in progress, remove individual human subjects from the study, and take whatever steps are necessary to protect the safety and well-being of human subjects until the IRB can assess the monitor's report. The Research Monitor is responsible for promptly reporting their observations and findings to the IRB.

Appendix E

Radiographic Guidelines

This study is designed to include men without radiographic evidence of metastases with the primary endpoint of various measures of time to the development of radiographic appearance of metastatic disease. It is understood that there may be instances when the determination of lack of radiographic evidence of metastases may be equivocal. The following general guidelines should be followed:

Equivocal bony lesions on bone scan should be evaluated by X-ray, CT, or MRI. If the etiology of the bone scan lesion may be explained by another cause (e.g. fracture), the lesion will not be considered evidence of osseous metastatic disease.

In the case of borderline lymphadenopathy, every attempt should be made to obtain historical scans. Should the lesion be present and stable over time and unchanged despite biochemical progression and in the opinion of the investigator does not represent metastatic disease from prostate cancer, the lesion will not be considered evidence of metastatic soft tissue disease.

Equivocal lesions suspicious for metastatic disease should be biopsied if feasible.

Keeping the guidelines in mind, any equivocal lesion should be assessed by the PI and may be discussed with the study chair. Images may also be sent for central review (assuming written informed consent has been provided).

Appendix F

Substitution for ketoconazole

In countries outside of the U.S. where the administration of ketoconazole for prostate cancer is prohibited, substitution of an alternative form of secondary hormonal therapy (or continuation of LHRH agonist/antagonist alone) with approval of the study chair will be allowed.

Appendix G

Functional Assessment of Cancer Therapy – Prostate (FACT-P), version 4

Appendix H

Summary of PIRADS V2 Scoring

Magnetic resonance imaging (MRI) is the reference standard imaging test for the local staging of prostatic carcinoma. Prostate cancer staging is according to the tumor nodes metastases (TNM) criteria established by the American Joint Committee on Cancer.

To overcome variation in the performance, interpretation, and reporting of prostate MRI exams, the European Society of Urogenital Radiology (ESUR) drafted guidelines for the MR imaging and MR reporting of prostate cancer with a specific radiology lexicon referred to as the PI-RADS system. Ever since then the use of PI-RADS version 1 (PI-RADS v1) for the identification and grading of tumor foci with MRI has garnered tremendous interest. However, experience from working with PI-RADS v1 has also revealed several limitations, in part due to rapid progress in the field. In an effort to make PI-RADS standardization more globally acceptable, the American College of Radiology (ACR), ESUR and the AdMeTech Foundation established a Steering Committee to build upon, update and improve upon the foundation of PI-RADS v1. This effort resulted in the development of PI-RADS v2.

Assignment of a PI-RADS v2 Assessment Category is based on multi-parametric MRI (mpMRI) findings only and does not incorporate other factors such as serum prostate specific antigen (PSA), digital rectal exam, clinical history, or the choice of treatment. A sector map (adapted from a European Consensus Meeting and the ESUR Prostate MRI Guidelines 2012) employing thirty-nine sectors/regions: thirty-six for the prostate, two for the seminal vesicles and one for the external urethral sphincter is used for standardized reporting and interpretation.

PI-RADS v2 Assessment Categories:

PIRADS 1– Very low (clinically significant cancer is highly unlikely to be present)

PIRADS 2– Low (clinically significant cancer is unlikely to be present)

PIRADS 3– Intermediate (the presence of clinically significant cancer is equivocal)

PIRADS 4– High (clinically significant cancer is likely to be present)

PIRADS 5– Very high (clinically significant cancer is highly likely to be present)

When assessing the peripheral zone lesions, diffusion-weighted imaging (DWI) component of the mpMRI is the primary determining sequence (dominant technique) for assigning the PIRADS score.

When assessing the transition zone lesions, T2-weighted pulse sequence (T2W) of the mpMRI is the primary determining sequence (dominant technique) for assigning the PIRADS score.

PI-RADS assessment for peripheral zone lesions:

DWI	T2W	DCE	PIRADS
1	Any	Any	1
2	Any	Any	2

3	Any	–	3
3	Any	+	4
4	Any	Any	4
5	Any	Any	5

PI–RADS assessment for transition zone lesions:

T2W	DWI	DCE	PIRADS
1	Any	Any	1
2	Any	Any	2
3	≤4	Any	3
3	5	Any	4
4	Any	Any	4
5	Any	Any	5

PI–RADS scoring for DWI:

Score	Peripheral Zone (PZ) or Transition Zone (TZ)
1	No abnormality (i.e. normal) on ADC and high b ₀ value DWI
2	Indistinct hypointense on ADC
3	Focal mildly/moderately hypointense on ADC and isointense/mildly hyperintense on high b ₀ value DWI.
4	Focal markedly hypointense on ADC and markedly hyperintense on high b ₀ value DWI; <1.5cm in greatest dimension
5	Same as 4 but ≥1.5cm in greatest dimension or definite extraprostatic extension/invasive behavior

PI–RADS scoring for T2W:

Score	Peripheral Zone (PZ)
1	Uniform hyperintense signal intensity (normal)
2	Linear or wedge-shaped hypointensity or diffuse mild hypointensity, usually indistinct margin
3	Heterogeneous signal intensity or non-circumscribed, rounded, moderate hypointensity. Includes others that do not qualify as 2, 4, or 5
4	Circumscribed, homogenous moderate hypointense focus/mass confined to prostate and <1.5 cm in greatest dimension
5	Same as 4 but ≥1.5cm in greatest dimension or definite extraprostatic extension/invasive behavior

PI–RADS scoring for T2W:

Score	Transition Zone (TZ)
1	Homogeneous intermediate signal intensity (normal)

2	Circumscribed hypointense or heterogeneous encapsulated nodule(s) (BPH)
3	Heterogeneous signal intensity with obscured margins. Includes others that do not qualify as 2, 4 or 5
4	Lenticular or non-circumscribed, homogeneous, moderately hypointense, and <1.5 cm in greatest dimension
5	Same as 4 but ≥ 1.5 cm in greatest dimension or definite extraprostatic extension/invasive behavior

PI-RADS scoring for DCE:

Score	Peripheral Zone (PZ) or Transition Zone (TZ)
(-)	No early enhancement, or diffuse enhancement not corresponding to a focal finding on T2W and/or DWI or focal enhancement corresponding to a lesion demonstrating features of BPH on T2W
(+)	Focal, and; earlier than or contemporaneously with enhancement of adjacent normal prostatic tissues, and; corresponds to suspicious finding on T2W and/or DWI

Patients diagnosed with PCa who have been treated earlier with hormonal therapy and are now progressed to castration resistant prostate cancer (CRPC) without any evidence of frank metastasis on conventional imaging modalities (CT scan, Bone scan, CXR) will be required to undergo 3-Tesla mpMRI. If their PI-RADS score is 3 or below, they will be included in the study since they are unlikely to have local disease progression.

EPE Scoring:

Standardized criteria used for assessment of extra-prostatic extension (EPE) at MRI proposed by the European Society of Uroradiology [1].

EPE Score	Original PI-RADS criteria	Modified PI-RADS criteria
1	Abutment	Clearly confined, intervening normal tissue between tumor and intact prostate capsule
2	Not specified	Abutment, tumor abuts but does not deform capsule
3	Irregularity	Irregularity, tumor abuts capsule causing capsular irregularity
4	Bulge, loss of capsule, neurovascular bundle thickening	Tumor bulges, deforms or obscures (loss of) capsule with or without neurovascular bundle thickening
5	Measurable extracapsular disease	Gross/measurable extracapsular disease

Note: 1) For PI-RADS v2 clinically significant cancer is defined on pathology/histology as Gleason score > 7 (including 3+4 with prominent but not predominant Gleason 4 component), and/or volume > 0.5 cc, and/or extraprostatic extension (EPE).

- 2) PI-RADS score of 5 for DWI and/or T2W represents lesion of ≥ 1.5 cm in greatest dimension [Ref: ESUR guidelines]
- 3) Higher tumor incidence correlates with higher PI-RADS score [1]
- 4) Imaging features used to assess for EPE include asymmetry or invasion of the neurovascular bundles, a bulging prostatic contour, an irregular or spiculated margin, obliteration of the rectoprostatic angle, a tumor-capsule interface of greater than 1.0 cm, breach of the capsule with evidence of direct tumor extension or bladder wall invasion. [Ref: ESUR guidelines]

Ref:

1. Schieda N, Quon J, Lim C, et al. Evaluation of the European Society of Urogenital Radiology (ESUR) PI-RADS scoring system for assessment of extra-prostatic extension in prostatic carcinoma, *Eur J Radiol* (2015), <http://dx.doi.org/10.1016/j.ejrad.2015.06.016>
2. Junker D, Schäfer G, Edlinger M, et al. Evaluation of the PI-RADS Scoring System for Classifying mpMRI Findings in Men with Suspicion of Prostate Cancer. *BioMed Research International*. 2013;2013:252939. doi:10.1155/2013/252939.

October 19, 2016

Scott T. Tagawa, MD

Submission Type: Continuing Review with Amendment
Protocol Number: 0810010067R008
Protocol Title: A Randomized Phase 2 Trial of Lu Radiolabeled Monoclonal Antibody HuJ591 (Lu-J591) and ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy.
Status of IRB Protocol: Open
Risk Level: Greater than Minimal Risk
Amendment Summary: The following co-investigators have been removed from the study: Caryn Ecker, NP; Stanley Goldsmith, MD; Ana Molina, MD.

Dear Dr. Tagawa:

The renewal for the abovementioned protocol was reviewed at the **October 19, 2016** meeting of the Institutional Review Board.

The protocol and its relevant documents stand approved for the following period:

- Consent Form for Clinical Investigation – 2/10/2016
- Subject Materials: Patient Brochure, Patient Info Card, Medication Diary, FACT-P
- DSMB Report – 5/26/2016
- IND Annual Report – 2/25/2016

Approved: 10/19/2016

Expires: 10/18/2017

Please do not hesitate to contact the IRB office staff if you have any questions or need assistance in complying with the terms of this approval.

Sincerely,



Alavy Sos, M.S.
Director, Institutional Review Board

Please note the following important information about this approval:

- No investigators on this study, who also serve as members of the Weill Cornell Medicine IRB, participated in the review, discussion or vote of this submission.
- **Billing Compliance:** This approval is contingent upon continued adherence with institutional billing compliance policies.
- **Immediate Reporting:** Investigators must follow the Immediate Reporting Policy at http://weill.cornell.edu/research/research_integrity/institutional_review_board/irb_adv.html



- Failure to comply with IRB directives within specified time frames may result in federally mandated penalties, up to and including suspension or termination of IRB approval and mandatory reporting to the Federal government.
- **Human Gene Transfer:** If this is a human gene transfer protocol, it is a term and condition of IRB approval that the principal investigator obtains Institutional Biosafety Committee (IBC) approval of all amendments prior to initiation, reportable adverse events as per WCMC policy, and annual reports as per M-I-C-3 of the NIH Guidelines for Research Involving Recombinant DNA Molecules. View the IBC website at http://weill.cornell.edu/research/research_integrity/ibc.html or contact ibc@med.cornell.edu if you require assistance in complying with these requirements.
- **Other reporting:** The reporting requirements of various regulatory bodies may differ with regard to both what must be reported and when. You are responsible for acquainting yourself with and abiding by all applicable federal and state regulatory reporting requirements.
- **Changes to this protocol:** If you want to change this research in any way or if any unanticipated hazardous conditions emerge affecting the rights or welfare of the human subjects involved in it, you must submit an amendment detailing these changes to the IRB for review and approval prior to implementing those changes. If the CTSC is used, the changes must also be submitted to the Translational Research Advisory Committee (TRAC). It is your responsibility to obtain approval for any such changes prior to initiating them.
- **Continuing approval:** You will receive a reminder via email for continuing review of this protocol in advance of the expiration date. The continuing review forms must be filed with the IRB sufficiently early to permit timely review and approval if the project is to continue beyond the period for which it was approved. Please note, no study related activities can continue beyond the WCMC IRB expiration date, including subject recruitment, enrollment, intervention and data analysis.
- **If your research study involves human tissues:** In addition to IRB approval, Section 4.4 of the hospital By-Laws “**Specimens Removed During Resective Surgery**” requires that all specimens removed during surgical diagnostic procedures that will be used for research must be approved by Pathology Service. Information about Pathology review can be found online at http://www.med.cornell.edu/research/for_pol/forms/Pathology_Review_Instructions.pdf
- **If the IRB is requiring that you obtain informed consent from subjects:** The signed IRB approved consent forms must be kept in the subject’s hospital chart. If the subject has no New York Presbyterian Hospital chart, you are responsible for retaining such signed forms in your research files.
- **Information about the WCMC IRBs:** The Weill Cornell Medical College (WCMC) Institutional Review Board (IRB) is constituted as required by the Federal Office for Human Research Protections (OHRP). WCMC holds a Federalwide Assurance (FWA) with OHRP. The FWA number is FWA00000093. The WCMC IRB is registered on that FWA. The registration number for the IRB is: General IRB #1 IRB00009417, General IRB #2 IRB00009418, Cancer IRB#1 IRB00009420, Cancer IRB#2 IRB00009421 and Expedited IRB IRB00009419. Should you need additional information about the terms of the WCMC FWA or the WCMC IRBs, please refer to http://weill.cornell.edu/research/research_integrity/institutional_review_board/index.html.
- Note that new federal legislation took effect April 7, 2008, (<http://grants.nih.gov/grants/guide/notice-files/NOT-OD-08-033.html>), requiring that all peer-reviewed journal articles resulting from NIH supported research be deposited in PubMed Central, the NIH free digital archive of biomedical and life sciences journal literature, and be made publicly available within twelve months of publication. The Library and RASP have prepared general information which you can see at: <http://library.med.cornell.edu/FacPub/nihpolicy.html>
- The International Committee of Medical Journal Editors (ICMJE) has established a requirement that all clinical trials be entered in a public registry before the onset of patient enrollment as a condition of consideration for publication. Additional information may be found at <http://clinicaltrials.gov/> and at http://www.icmje.org/clin_trialup.htm Please contact the Protocol Registration System (“PRS”) administrator by e-mail at jctooperations@med.cornell.edu to set up a PRS user account to register new and ongoing investigator-initiated clinical trials. The e-mail should contain the PIs full name, department, phone number and e-mail address.



**Joan and Sanford I. Weill
Medical College**

Department of Medicine
Division of Hematology and Medical Oncology

Telephone: 212 746-2060
Fax: 212 746-8866

525 East 68th Street
New York, NY 10021

June 24, 2009

RE: **PC081664**: "A Randomized Phase 2 Trial of ¹⁷⁷Lu Radiolabeled Monoclonal Antibody HuJ591 (¹⁷⁷Lu-J591) and ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy"

Dear Ms. Scassero:

The referenced study is a multicenter study led and sponsored by Weill Cornell Medical College (WCMC).

The Clinical Trial Award funds from the DOD PCRP will be used only by WCMC as specified in the attached (revised) budget / budget justification. This includes funds for personnel (study chair, statistician, regulatory coordinator, data manager, research nurse), supplies (study drug, radionuclides, lab supplies), and travel costs (meetings, site initiation/monitoring visits). No DOD funds will be used to pay the additional study sites directly, though funds may be used to ship DOD-funded supplies (study drug, lab supplies) to the additional sites.

Aside from the proposed DOD funds, WCMC investigators have additional funding through other sources to pay for the conduct of the clinical trial. Additional sources of funding come from non-trial specific funds in the WCMC Genitourinary Research Fund, directed by Neil Bander, MD. Each site's start-up costs as well as per subject costs will be provided via this fund. Please see separate letter from confirming full support of this trial (*Attachment #1*). Part of the Study Chair's funding is via a K12 mechanism (KL2 RR024997-01 (PI: Imperato-McGinley) K12 Clinical & Translational Research Training Scholars Award) and a Prostate Cancer Foundation Young Investigator Award to cover his time and effort in the development and conduct of the protocol. There is some overlap on these grants. The study will be performed at the WCMC Clinical and Translational Science Center through funds via the WCMC Clinical and Translational Science Award and additional sites may also receive support via their CTSA's (the majority of additional sites were selected based upon their available CTSA funds). The study has been approved at the WCMC as of April 27, 2009 (see attached letter of approval, *Attachment #2*). All WCMC subjects will be treated there and the WCMC CTSC will fund/perform several of the correlative studies.

The investigators at the initial core sites (signed collaboration letters attached to initial grant submission) as well as the other proposed sites have been updated on current study status. As we now have full IRB and CTSC approval at WCMC and the FDA did not place the study on hold, we have moved forward with

regulatory and contractual negotiations with other sites. Upon full agreement with the DOD, it will be made clear to each site that the study will be partially funded by the DOD and that amendments to the protocol at WCMC may be put in place based upon DOD feedback and that WCMC investigators will be reporting safety and data to the DOD in addition to the external WCMC Data Safety Monitoring Board.

Additional information:

In response to email dated May 28, 2009 from Shannyn Scassero, please note the following:

- 1) See above and attached letter of financial support + Budget for non-DOD funded items (*Attachment #1*)
- 2) Please see attached CTSC approval letter + letter of support (*Attachment #2*)
- 3) See #1 above, attached sample inter-institutional agreement and available updated letters of collaboration (*Attachment #3*)
- 4) See revised SOW attached (*Attachment #4*) as well as #10 for projected accrual per site
- 5) See revised SOW attached (*Attachment #4*)
- 6) Key Personnel are listed in Section 15 of the protocol (with additional names and duties listed in attached amendment) (*Attachment #5*)

In addition, the WCMC Division of Hematology and Medical Oncology Clinical Trials Office will provide key support for the trial. This office is comprised of a Director (John Leonard, MD), Senior Administrators (Alicia Lewis, Jamie Ketas), Regulatory Coordinators, Data Managers, and Investigators. In addition to the key personnel listed who are already listed in Section 15 of the amended protocol (John Leonard, Sharmaine Lewis, Dan Matulich, Kristen Petrillo) additional key personnel in this office include:

Alicia Lewis, Senior Clinical Trials Administrator will provide oversight to the office and all of its personnel (including Sharmaine Lewis, Dan Matulich, and Kristen Petrillo).

Koty Nadeau, Regulatory Manager, will provide oversight to Sharmaine Lewis and in particular, will oversee interactions with the FDA and additional study sites.

- 7) See attached (*Attachment #6*)
- 8) See revised budget + budget justification (*Attachment #7*)
- 9) See revised budget + budget justification (*Attachment #7*)
- 10) Weill Cornell is still in the process of finalizing additional study sites. Based upon direct feedback from sites with consideration for their current patient population meeting trial entry criteria and considering competing clinical trials (or lack thereof), the following sites have provided details regarding anticipated enrollment:

University of Southern California: 4 subjects per year

Yale University: 10 subjects per year

University of Pennsylvania: 5 subjects per year

University of Washington: 2-4 subjects per month

University of Iowa: 5-7 subjects per month

Indiana University: 10 subjects per year

Emory University: 20 subjects per year

Stanford University: 10 subjects per year

Washington University: 1 subject per month

Additional sites which have confirmed interest in participating, but have not yet returned pre-study surveys regarding anticipated enrollment include the University of Pittsburgh and Tulane University. Other sites with preliminary interest in participation include Johns Hopkins University, Duke University, Northwestern University, and the University of Utah. We are awaiting a preliminary response from the University of California San Diego and University of California Davis.

In addition, WCMC investigators anticipate enrollment of 10 subjects per year.

Sincerely,



Scott T. Tagawa, MD

Attachments:

- #1: Letter of financial support + Budget for non-DOD supported items
- #2: WCMC CTSC Approval Letter, Letter of support from CTSC
- #3: Sample inter-institutional contract and Letters of collaboration from sites (received to date)
- #4: Revised SOW
- #5: Revised Section #15 from amended protocol (Key Personnel) + Letter of support from
Director of Clinical Trials Office
- #6: Salary verification
- #7: Revised budget + justification

CORNELL
UNIVERSITY

NEW YORK
PRESBYTERIAN
HOSPITAL

Joan and Sanford I. Weill
Medical College

Neil H. Bander, M.D.
*Bernard and Josephine Chaus Professor
of Urologic Oncology*

James Buchanan Brady Foundation
Department of Urology
Box 23, Room E-300
525 East 68th Street
New York, NY 10021

Administrative: 212-746-5493
Clinical: 212-746-5460
Fax: 212-746-8941
nhbander@med.cornell.edu
www.nycornell.org/uo/

June 5, 2009

Scott T. Tagawa, MD
Assistant Professor of Medicine & Urology
Weill Cornell Medical College
525 E. 68th St., Starr 341
New York, NY 10065

Dear Scott,

I am happy to write this letter in support of your DOD grant application PC081664 entitled "A Randomized Phase 2 Trial of ¹⁷⁷Lu Radiolabeled Monoclonal Antibody HuJ591 (¹⁷⁷Lu-J591) and ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy".

I understand that you are in negotiations with the DOD to fund a portion of the trial, including the costs of the monoclonal antibody J591 and the radionuclides, some correlative studies, and time and effort for key personnel at WCMC. No DOD funds will be used to support other sites. As director of the WCMC Genitourinary Research Fund, I agree to support the clinical trial with these funds. With the understanding that each site will be urged to apply for additional support via their CTSA, I have reviewed the anticipated study budget which is external to the DOD-supported items and agree to fund the approximate \$529,450 anticipated to complete the study. This will cover start up costs for each site, reimburse site personnel for time/effort in the conduct of the study, and pay for some correlative studies.

This clinical trial is an innovative and important study which may improve the lives of men affected by the most common cancer in men. I look forward to collaborative efforts.

Sincerely,



Neil H. Bander, M.D.
Bernard & Josephine Chaus Professor
Director, Laboratory of Urological Oncology



BARBARA PIFEL, J.D., M.B.A., R.N.

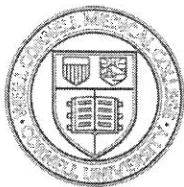
ASSOCIATE DEAN, SPONSORED PROGRAMS

Study Budget - non-DOD covered items*applies to all NON-WCMC participating sites*

Budget Item	Unit cost	# units	total	Indirect	TOTAL COST
Site start up costs	3000	11	33000	25%	\$41,250.00
Per subject reimbursement	2500	110	275000	25%	\$343,750.00
CTC Counting Kits	2500	45	112500	N/A	\$112,500.00
CTC Processing Kits	1500	18	27000	N/A	\$27,000.00
CTC Tubes	495	10	4950	N/A	\$4,950.00

TOTAL \$529,450.00

Item	Description/Amount	Justification			
Site Start-Up Costs	\$3000 per site	Administrative start up fees including scientific committee submission/review, IRB submission/review			
Per Subject Reimbursement	\$2500/subject	Time/effort for investigator, research nurse, data manager; preparation/processing of correlative studies; radiolabeled J591 scan			
J591 scans	\$300 per scan	Scan, shipping for central reading			
CTC Counting Kit	\$2500 per kit	16 samples per kit; 635 samples per study			
CTC Processing Kit	\$1500 per kit	16 samples per kit; 635 samples per study			
CTC tubes	\$495 per box				



Weill Cornell Medical College



Clinical & Translational Science Center

A Multi-Institutional Consortium

Cornell University, Ithaca

Cornell University Cooperative Extension, New York City

Hospital for Special Surgery

Hunter Center for Study of Gene Structure and Function

Hunter-Bellevue School of Nursing

Memorial Sloan-Kettering Cancer Center

1300 York Ave, Box 149, New York, NY 10065 • Tel: 212-746-4745 • Fax: 212-746-8922 • www.med.cornell.edu/ctsc

June 1, 2009

Scott T. Tagawa, MD
Assistant Professor of Medicine & Urology
Weill Cornell Medical College
525 E. 68th St., Starr 341
New York, NY 10065

Dear Scott,

I am extremely pleased to write this letter in support of your DOD grant application entitled "A Randomized Phase 2 Trial of ¹⁷⁷Lu Radiolabeled Monoclonal Antibody HuJ591 (¹⁷⁷Lu-J591) and ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy". As Program Director of the Weill Cornell Clinical & Translational Science Center (CTSC), I am excited about your plans to utilize CTSC resources to facilitate your research endeavors and their potentially transformative impact on the treatment of men with biochemically recurrent prostate cancer. This multicenter proposal utilizing CTSA's across the country is exactly the sort of program that our CTSC was developed to support. I am happy to say that your proposal was granted full approval on April 27, 2009.

As you know, the CTSC is a multi-institutional team endeavor designed to promote translational research and multidisciplinary collaboration with our partner institutions. A primary function of the CTSC is to support investigator-initiated clinical and translational research at Weill Cornell. The CTSC provides a well-coordinated and integrated clinical and translational research infrastructure that utilizes the expertise of our diverse trans-institutional faculty and resources.

The CTSC will be able to help you in several key areas including database design and management, biostatistical support and analysis, and community outreach. In fact, several Core Services established as part of the CTSC can function as cores within your proposed Coordinating Center. As a co-investigator, Paul Christos will provide statistical support for your project and will help with the statistical design of your protocols and with the analysis of your study results. Dr. Madhu Mazumdar, Director of the Biostatistics Core, will provide guidance to Paul and you throughout the conduct of the study. Bioinformatics Co-Director, Elizabeth Wood will work with Jessie Lee to build your customized database and ensure it is complete, secure, usable and accessible. The CTSC Bioinformatics Core will also provide training to you and your staff in research data management. As you know, an important part of the CTSC mission is to serve as a training facility for postdoctoral fellows, residents and medical students involved in clinical and translational research.

The CTSC also offers both inpatient and outpatient facilities to support clinical research should these services be required for your clinical trials. The Clinical and Translational Research Unit (CTRU) is located within Weill-Cornell/The New York Presbyterian Hospital. The facilities include Core Laboratories, Informatics Core, Metabolic Kitchen, and Molecular Core. The renovated inpatient unit includes 6 rooms with 9 beds, all of which are designated for research and staffed and equipped 7 days, 24 hours. The nursing station, nurse manager's office and metabolic kitchen are also located here. The outpatient unit, located on the adjoining corridor, includes six examination rooms and is fully-equipped for a range of metabolic and physiologic examination, as well as for outpatient follow-up visits. The outpatient unit has a large and comfortable waiting room, a lavatory, a special

study room for continuous infusion studies, and facilities for blood sampling or other procedures requiring special equipment.

As the most common cancer to affect men in the United States, prostate cancer is certainly an important disease. Although we have made improvements in the care of men with this disease, far too many men suffer from recurrent cancer after surgery and/or radiotherapy and research such as yours is vital to decrease morbidity and mortality from this disease. This project is important to the mission of CTSC, and my staff and I offer you our full support.

Sincerely,

A handwritten signature in black ink, reading "Julianne Imperato-McGinley". The signature is written in a cursive, flowing style.

Julianne Imperato-McGinley, MD
Associate Dean, Translational Research and Education
Program Director, Clinical and Translational Science Center
Abby Rockefeller Mauzé Distinguished Professor of Endocrinology in Medicine
Chief, Division of Endocrinology



Weill Cornell Medical College

1300 York Ave, Box 149, New York, NY 10065 • Tel: 212-746-4745 • Fax: 212-746-8922 • www.med.cornell.edu/ctsc



Clinical & Translational Science Center

A Multi-Institutional Consortium

Cornell University, Ithaca

Cornell University Cooperative Extension, New York City

Hospital for Special Surgery

Hunter Center for Study of Gene Structure and Function

Hunter-Bellevue School of Nursing

Memorial Sloan-Kettering Cancer Center

May 5, 2009

Scott Tagawa, MD
Assistant Professor of Medicine and Urology
Starr 341

Re: **Protocol # 0810010067 / A Randomized Phase 2 Trial of 177Lu Radiolabeled Monoclonal Antibody HuJ591 (177Lu-J591) and ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy**

Dear Dr. Tagawa;

On behalf of the CTSC Translational Research Advisory Committee, I thank you for the response to the committee's additional questions regarding the above-captioned protocol. The response and revisions were reviewed, and I am pleased to inform you that your protocol stands approved for CTSC utilization as of April 27, 2009, *pending submission of all pertinent documents (see attached memorandum).*

The level of risk assigned is: Greater than Minimal
The DSMP was approved / DSMB in place

The CTSC's budget is dependent on year-to-year support granted by Congress through the NIH. Our support of this study beyond the current calendar year is dependent on appropriate continued federal support to our unit.

Please note and inform all co-investigators and personnel working on this study of the following regulations:

1. If there are any changes in design or resources required from the CTSC, or any amendments to the protocol or any regulatory documents (e. g consent form), these must be submitted to the CTSC Translational Research Advisory Committee (TRAC) **prior to initiation** of any change in the project.
2. Reports that must be submitted to the CTSC Research Subject Advocates include:
 - a. Copies of all unanticipated adverse events within 5 days (as mandated by the IRB)
 - b. Copies of reports issued by Data and Safety Monitoring Boards/Committees
 - c. A copy of the annual IRB Continuing Review Form

We thank you for your cooperation. The CTSC staff is always available to help make your research at the Center pleasant and productive.

Sincerely,

Kurt H. Stenzel, M.D.

Chairman- CTSC Translational Research Advisory Committee-Adult Unit

Attached: Memorandum

cc: Julianne Imperato-McGinley, M.D., CTSC Principal Investigator and Program Director

October 2008 FDP

Research Subaward Agreement

Institution/Organization ("Prime Recipient")

Name: Joan & Sanford I. Weill Medical College of Cornell University

Prime Award No.: NONE

Awarding Agency:

Institution/Organization ("Subrecipient")

Name: Yale University

Subaward No.:

CFDA #:

Amount Funded This Action:

Est. Total (if incrementally funded)

Subaward Period of Performance:

Budget Period: From:

To:

07/01/2009

06/30/2012

Estimated Project Period (if incrementally funded):

From:

To:

Project Title:

A Randomized Phase 2 Trial of 177Lu Radiolabeled Monoclonal Antibody HuJ591 (177Lu-J591) and ketoconazole in Patients with High-Risk Castrate Biochemically Relapsing

Reporting Requirements (Check here if applicable: ☐ See Attachment 4)

Terms & Conditions

- 1) Prime Recipient hereby awards a cost reimbursable subaward, as described above, to Subrecipient. The statement of work and budget for this subaward are (check one): ☐ As specified in Subrecipient's proposal dated _____; or ☒ as shown in Attachment 5. In its performance of the subaward work, Subrecipient shall be an independent entity and not an employee or agent of Prime Recipient.
- 2) Prime Recipient shall reimburse Subrecipient not more often than monthly for allowable costs. All invoices shall be submitted using Subrecipient's standard invoice, but at a minimum shall include current and cumulative costs (including cost sharing), subaward number, and certification as to truth and accuracy of invoice. *Invoices that do not reference Prime Recipient's Subaward Number shall be returned to Subrecipient.* Invoices and questions concerning invoice receipt or payments should be directed to the appropriate party's ☐ Financial ☐ Contact as shown in Attachments 3A & 3B.
- 3) A final statement of cumulative costs incurred, including cost sharing, marked "FINAL" must be submitted to Prime Recipient's ☐ Financial ☐ Contact, as shown in Attachments 3A and 3B, NOT LATER THAN sixty (60) days after subaward end date. The final statement of costs shall constitute Subrecipient's final financial report.
- 4) All payments shall be considered provisional and subject to adjustment within the total estimated cost in the event such adjustment is necessary as a result of an adverse audit finding against the Subrecipient.
- 5) Matters concerning the technical performance of this subaward should be directed to the appropriate party's Principal Investigator, as shown in Attachments 3A and 3B. Technical reports are required as shown above, "Reporting Requirements".
- 6) Matters concerning the request or negotiation of any changes in the terms, conditions, or amounts cited in this subaward agreement, and any changes requiring prior approval, should be directed to the appropriate party's ☐ Administrative ☐ Contact, as shown in Attachments 3A & 3B. Any such changes made to this subaward agreement require the written approval of each party's Authorized Official as shown in Attachments 3A & 3B.
- 7) Each party shall be responsible for its negligent acts or omissions and the negligent acts or omissions of its employees, officers, or director's, to the extent allowed by law.
- 8) Either party may terminate this subaward with thirty days written notice to the appropriate party's ☐ Administrative ☐ Contact as shown in Attachments 3A & 3B. Prime Recipient shall pay Subrecipient for termination costs as allowable under OMB Circular A-21 or A-122 or 45 CFR Part 74 Appendix E, "Principles for Determining Costs Applicable to Research and Development under Grants and Contracts with Hospitals" as applicable.
- 9) No-cost extensions require the approval of the Prime Recipient. Any requests for a no-cost extension should be addressed to and received by the ☐ Financial ☐ Contact, as shown in Attachments 3A & 3B, not less than thirty (30) days prior to the desired effective date of the requested change.
- 10) The Subaward is subject to the terms and conditions of the Prime Award and other special terms and conditions, as identified in Attachment 2.
- 11) By signing below Subrecipient makes the certifications and assurances shown in Attachments 1 and 2. Subrecipient also assures that it will comply with applicable statutory and regulatory requirements specified in the Research Terms & Conditions Appendix C found at <http://www.nsf.gov/bfa/dias/policy/rtc/appc.pdf>.

By an Authorized Official of Prime Recipient

By an Authorized Official of Subrecipient

Barbara Pfeil, JD, MBA, RN
Associate Dean, Sponsored Programs

Date

Date

Attachment 1

Research Subaward Agreement

Certifications and Assurances

By signing the Subaward Agreement, the authorized official of Subrecipient certifies, to the best of his/her knowledge and belief that:

Certification Regarding Lobbying

1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the Subrecipient, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or intending to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the Subrecipient shall complete and submit Standard Form -LLL, "Disclosure Form to Report Lobbying", to the Prime Recipient.

3) The Subrecipient shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Debarment, Suspension, and Other Responsibility Matters

Subrecipient certifies by signing this Subaward Agreement that neither it nor its principals are presently debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from participation in this transaction by any federal department or agency.

OMB Circular A-133 Assurance

Subrecipient assures Prime Recipient that it complies with A-133 and that it will notify Prime Recipient of completion of required audits and of any adverse findings which impact this subaward.

Attachment 3A
Research Subaward Agreement

Subaward Number:

Prime Recipient Contacts

Institution/Organization ("Prime Recipient")

Name: Joan & Sanford I. Weill Medical College of Cornell University

Address: 1300 York Avenue, Box 305

City: New York

State: NY

ZipCode: 10065

Administrative Contact

Name: Melanie Lebedowicz, Senior Grants and Contracts Specialist

Address: 407 East 61st Street

City: New York

State: NY

ZipCode: 10065

Telephone: 646-962-8212

Fax: 646-962-0531

Email: mel2011@med.cornell.edu

Principal Investigator

Name: Dr. Scott Tagawa

Address: 525 East 68th Street, Starr 341

City: New York

State: NY

ZipCode: 10065

Telephone: 212-746-6717

Fax: 212-746-6645

Email: stt2007@med.cornell.edu

Financial Contact

Name: Randall H. Phillips, Manager, Grant Accounting

Address: 100 Broadway, 8th Floor

City: New York

State: NY

ZipCode: 10005-1983

Telephone: 212-680-7131

Fax: 212-680-6704

Email: rhphilli@med.cornell.edu

Authorized Official

Name: Barbara Pifel, JD, MBA, RN

Address: 1300 York Avenue, Box 305

City: New York

State: NY

ZipCode: 10065

Telephone: 646-962-8215

Fax: 646-962-0531

Email: bLp2001@med.cornell.edu

Attachment 3B
Research Subaward Agreement

Subaward Number:

Subrecipient Contacts

Institution/Organization ("Subrecipient")

Name:

Address:

City: State: ZipCode:

EIN No.:

DUNS No.: Congressional District: Congressional District: Congressional District:

Reg. in CCR? ☐ Yes ☐ No

Administrative Contact

Name:

Address:

City: State: ZipCode:

Telephone: Fax:

Email:

Principal Investigator

Name:

Address:

City: State: ZipCode:

Telephone: Fax:

Email:

Financial Contact

Name:

Address:

City: State: ZipCode:

Telephone: Fax:

Email:

Authorized Official

Name:

Address:

City: State: ZipCode:

Telephone: Fax:

Email:

ATTACHMENT 5

to

RESEARCH SUBAWARD AGREEMENT

between

**JOAN & SANFORD I. WEILL MEDICAL COLLEGE OF CORNELL
UNIVERSITY**

and

YALE UNIVERSITY

for

**A Randomized Phase 2 Trial of 177Lu Radiolabeled Monoclonal Antibody HuJ591
(177Lu-J591) and ketoconazole in Patients with High-Risk Castrate Biochemically
Relapsed Prostate Cancer After Local Therapy ("Study")**

The Department of Defense ("DoD") will be providing funds to The Joan & Sanford I. Weill Medical College of Cornell University ("Cornell") to partially fund the Study. The DoD funds will not be used to support participating sites, however some of the monies from the DoD will be used to pay for the preparation of the Study agent. Cornell will provide funds from an internal Cornell account, The Genitourinary Research Fund. These funds will cover the costs of clinical trial performance on a per patient basis. The funding will be in the amount of two thousand five hundred dollars (\$2,500.00) per randomized subject (this amount includes the indirect costs). In addition, Cornell will reimburse the initial IRB fee upon receipt of an invoice from Yale University.

Cornell will also reimburse Yale University for a one-time start-up fee for the study in the amount of _____. [Please insert the amount of your start-up fees.]

Receipient will provide the following support to the study:

Receipient Main Investigator _____ [please insert name] will dedicate effort in accordance wiht institutional rules and regualtions in effect at the receipient subsite.

IRB approval documents will be forwarded to the main site prior to the start of the study at the receipnet subsite.

Study progress and final reslusts will be communicated to the Principal Investigator, Dr. S. Tagawa. Receipient Main Investigator will be available to discuss progress and results of the study as needed and per request from the Principal Investigator.



STANFORD CANCER CENTER

Stanford Hospital & Clinics

June 5, 2009

Scott T. Tagawa
Assistant Professor of Medicine & Urology
Weill Cornell Medical College
525 E. 68th St., Starr 341
New York, NY 10065

Dear Dr. Tagawa:

This is to confirm my intent to collaborate with you and other investigators at Weill Cornell Medical College (WCMC) on **"A Randomized Phase 2 Trial of ¹⁷⁷Lu Radiolabeled Monoclonal Antibody HuJ591 (¹⁷⁷Lu-J591) and Ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer"**. I understand that while the Department of Defense will provide funds to WCMC to partially fund this project, this funding will not be used to directly support our site. I agree to commit 1% effort in support of this trial.

It is our understanding that WCMC is in the process of establishing contractual agreements with our site to outline legal and monetary arrangements for the proposed work. This agreement will provide funds from internal WCMC accounts to cover the costs of clinical trial performance at our site on "per patient" basis in accordance with our budgetary estimates. While we understand that this contract is under negotiation, it is expected to be in the range of \$3000 for time/effort in start-up costs and \$2500 per subject treated to cover investigator, nurse, data manager, and regulatory coordinator time/effort. It is expected that each subject's insurance will cover the standard of care costs of treatment (physician payments, drug costs, routine labs, CT/MRI and bone scan costs).

Based upon the inclusion/exclusion criteria and competing clinical trials (or lack thereof), we expect to enroll approximately 10 subjects per year.

Sincerely,



SANDY SRINIVAS, M.D.
Associate Professor
Medicine/Oncology

Yale CANCER CENTER

A Comprehensive Cancer Center Designated
by the National Cancer Institute

William K. Kelly
Medical Oncology
333 Cedar Street
PO Box 208028
New Haven, Connecticut
06520-8028

Phone 203.737.2572
Fax 203.785.3788
wm.kevin.kelly@yale.edu

June 5, 2009

Scott T. Tagawa
Assistant Professor of Medicine & Urology
Weill Cornell Medical College
525 E. 68th St., Starr 341
New York, NY 10065

Dear Dr. Tagawa:

This is to confirm my intent to collaborate with you and other investigators at Weill Cornell Medical College (WCMC) on **"A Randomized Phase 2 Trial of ¹⁷⁷Lu Radiolabeled Monoclonal Antibody HuJ591 (¹⁷⁷Lu-J591) and Ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer"**. I understand that while the Department of Defense will provide funds to WCMC to partially fund this project, this funding will not be used to directly support our site. I agree to commit 1% effort in support of this trial.

It is our understanding that WCMC is in the process of establishing contractual agreements with our site to outline legal and monetary arrangements for the proposed work. This agreement will provide funds from internal WCMC accounts to cover the costs of clinical trial performance at our site on "per patient" basis in accordance with our budgetary estimates. While we understand that this contract is under negotiation, it is expected to be in the range of \$3000 for time/effort in start-up costs and \$2500 per subject treated to cover investigator, nurse, data manager, and regulatory coordinator time/effort. It is expected that each subject's insurance will cover the standard of care costs of treatment (physician payments, drug costs, routine labs, CT/MRI and bone scan costs).

Based upon the inclusion/exclusion criteria and competing clinical trials (or lack thereof), we expect to enroll approximately 10 subjects per year.

Sincerely,



Wm. Kevin Kelly, DO
Associate Professor of Medicine and Surgery
Yale School of Medicine



Yale School of Medicine

Yale Medical Group
THE PHYSICIANS OF
YALE UNIVERSITY





EMORY
UNIVERSITY
SCHOOL OF
MEDICINE

Department of Hematology and Medical Oncology

June 5, 2009

Scott T. Tagawa
Assistant Professor of Medicine & Urology
Weill Cornell Medical College
525 E. 68th St., Starr 341
New York, NY 10065

Dear Dr. Tagawa:

This is to confirm my intent to collaborate with you and other investigators at Weill Cornell Medical College (WCMC) on "A Randomized Phase 2 Trial of ¹⁷⁷Lu Radiolabeled Monoclonal Antibody HuJ591 (¹⁷⁷Lu-J591) and Ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer". I understand that while the Department of Defense will provide funds to WCMC to partially fund this project, this funding will not be used to directly support our site. I agree to commit 1% effort in support of this trial.

It is our understanding that WCMC is in the process of establishing contractual agreements with our site to outline legal and monetary arrangements for the proposed work. This agreement will provide funds from internal WCMC accounts to cover the costs of clinical trial performance at our site on "per patient" basis in accordance with our budgetary estimates. While we understand that this contract is under negotiation, it is expected to be in the range of \$3000 for time/effort in start-up costs and \$2500 per subject treated to cover investigator, nurse, data manager, and regulatory coordinator time/effort. It is expected that each subject's insurance will cover the standard of care costs of treatment (physician payments, drug costs, routine labs, CT/MRI and bone scan costs).

Based upon the inclusion/exclusion criteria and competing clinical trials (or lack thereof), we expect to enroll approximately 20 subjects per year.

Sincerely,

Omer Kucuk, MD
Professor of Hematology and Medical Oncology, and Urology
Emory Winship Cancer Institute

Emory Winship Cancer Institute
1365 Clifton Road
Atlanta, Georgia 30322
The Robert W. Woodruff Health Sciences Center
An equal opportunity, affirmative action university



UNIVERSITY OF
PENNSYLVANIA
HEALTH SYSTEM

Department of Medicine
Division of Hematology/Oncology
Naomi B. Haas, M.D.
Associate Professor

June 5, 2009

Scott T. Tagawa
Assistant Professor of Medicine & Urology
Weill Cornell Medical College
525 E. 68th St., Starr 341
New York, NY 10065

Dear Dr. Tagawa:

This is to confirm my intent to collaborate with you and other investigators at Weill Cornell Medical College (WCMC) on **"A Randomized Phase 2 Trial of ¹⁷⁷Lu Radiolabeled Monoclonal Antibody HuJ591 (¹⁷⁷Lu-J591) and Ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer"**. I understand that while the Department of Defense will provide funds to WCMC to partially fund this project, this funding will not be used to directly support our site. I agree to commit 1% effort in support of this trial.

It is our understanding that WCMC is in the process of establishing contractual agreements with our site to outline legal and monetary arrangements for the proposed work. This agreement will provide funds from internal WCMC accounts to cover the costs of clinical trial performance at our site on "per patient" basis in accordance with our budgetary estimates. While we understand that this contract is under negotiation, it is expected to be in the range of \$3000 for time/effort in start-up costs and \$2500 per subject treated to cover investigator, nurse, data manager, and regulatory coordinator time/effort. It is expected that each subject's insurance will cover the standard of care costs of treatment (physician payments, drug costs, routine labs, CT/MRI and bone scan costs).

Based upon the inclusion/exclusion criteria and competing clinical trials (or lack thereof), we expect to enroll approximately 5 subjects per year.

Sincerely,

Naomi B Haas, MD
Associate Professor of Medicine
Abramson Cancer Center/University of Pennsylvania
12 Penn Tower
3400 Spruce Street
Philadelphia, PA 19104

Task 1: Completion of regulatory review, Clinical Trial Startup (Months 1 to 6)

Note: Plan for clinical trial to be initiated at WCMC using other funds prior to Award (See Protocol Section 16, Funding);

- a. Completion of contractual agreements between WCMC and other core investigational sites
- b. Approval and initiation of trial at core sites
- c. Site initiation visits when necessary
- d. Review of protocol by ORP, revisions submitted

Milestone: Clinical trial approval at all core sites, Protocol approval by ORP

Task 2: Completion of initial (safety confirmation) portion of trial (Months 1 to 6)

- a. Screen, enroll, and treat 9 eligible subjects (*planned by October, 2009*)
- b. Review safety data in real time
- c. Communicate with agencies (IRB, DSMB, FDA, etc.) on progress

Milestone: Complete enrollment of initial 9 subjects (*by October, 2009*), Perform initial safety review (*by December, 2009*)

Task 3: Clinical trial performance (Months 1-36)

- a. Clinical trial initiation at remaining sites
 - 1. Submit to institutional regulatory bodies by August 1, 2009
- b. Screen, enroll, and treat up to 140 subjects
 - 1. Anticipate accrual of 4-6 subjects per year per site
- c. Ongoing communication with study sites
 - 1. Real time communication via electronic email, phone, electronic CRF's
 - 2. Queries via email, fax, phone, electronic submission
 - 3. Monthly conference calls with site PI's and study personnel
 - 4. Site visits when deemed necessary
- d. Ongoing communication by WCMC with IRB, DSMB, FDA, etc.
 - 1. Real time updates on adverse events
 - 2. At least semi-annual DSMB review

Milestones: Trial approval at all sites (*by Dec 31, 2009*), enrollment of initial 80 subjects by 1/1/11, completion of annual renewals

Task 4: Interim analysis (Approximately months 12-30)

- a. Verification of data
 - 1. Completion of queries to study sites
 - 2. Site visits when deemed necessary
- b. Compilation of data to DSMB for review

Milestone: Review of interim analysis

Task 5: Investigator analysis, reporting of initial data (Months 12-36)

- a. Verification of data
 - 1. Completion of queries to study sites
 - 2. Site visits when deemed necessary
- b. Analysis of initial data
 - 1. Demographic data
 - 2. Toxicity data
 - 3. PSA response
 - 4. Adrenal androgen levels
 - 5. Plasma markers of hemostasis, fibrinolysis, angiogenesis
 - 6. Circulating tumor cells
- c. Reporting of initial data

Note: Analysis of secondary endpoint related to treatment with ketoconazole (while remaining blinded to study drug) as well as reporting of this data will occur prior to study completion

Milestones: Reporting of initial data (toxicity, PSA response) in abstract form (goal = ASCO 2011)

Task 6: Analysis and reporting of final data (Months 24-36+)

- a. Verification of data
 - 1. Completion of queries to study sites
 - 2. Site visits when deemed necessary
- b. Analysis of data
 - 1. Demographic data
 - 2. Toxicity data
 - 3. Metastasis free proportion, metastasis free survival
 - 4. J591 Imaging
 - 5. PSA response
 - 6. Time to PSA progression
 - 7. Circulating tumor cells
- c. Reporting of final data in abstract form
- d. Manuscript submission

Milestones: Reporting of additional preliminary data (biochemical progression, correlative studies) ASCO 2012. Post-award reporting of primary endpoint (goal ASCO 2013) followed by publication in manuscript form.

15. Study Personnel

Study Chair (Scott T. Tagawa, MD): Responsible for patient recruitment and over-all clinical management, protocol design and coordination, assessment of adverse events, safety, toxicity, and effect of treatment. Will communicate with principal investigators and study personnel at all sites and run monthly study teleconferences with the Study Coordinator. Will oversee any changes to the protocol and will be responsible for submitting amendments to the appropriate regulatory agencies (such as IRB, DSMB, sponsors, FDA, etc.). [See also Appendix D]

Co-Investigators (David M. Nanus, MD, Joseph Osborne, MD, PhD, Jodi Selzer, FNP, Himisha Beltran, MD): Responsible for patient recruitment, overall clinical management, assessment of adverse events, safety, toxicity, and effect of treatment. Will assist with protocol design and coordination, interpretation of scans.

Nuclear Medicine Chairs (Stanley Goldsmith, MD, Shankar Vallabhajosula, PhD): Responsible for administration of IND agents (radiolabeled J591 antibodies) for diagnostic and therapeutic studies, will oversee evaluation and quantitation of radiolabeled J591 scans. Will oversee quality control of radiolabeled antibody.

Statistician (Paul Christos, MS): Assist with study design, data analysis and interpretation, assist with protocol amendments.

Research Nurse (Kristen Petrillo, RN): Assist with patient recruitment, study drug administration, documentation of adverse events.

Study Coordinator and Data Manager (Sharmaine Lewis, BA, Dan Matulich, BS): Assist with pre-screening and screening of subjects at WCMC; communicate with DOD; coordinate potential and enrolled subjects at all sites; optimize accurate data collection and entry by communicating frequently with other sites; prepare data for analysis. Will run monthly study teleconferences with principal investigators and other study team members at other sites in conjunction with the Study Chair. Will assist the Study Chair in providing continuing review documents for appropriate regulatory agencies (such as IRB, DSMB, sponsors).

Medical Monitor (John Leonard, MD): Will oversee clinical trial adverse events and assist in interpretation of severity and relationship of adverse events to study drug. The medical monitor is required to review all unanticipated problems involving risk to volunteers or others, serious adverse events, and all volunteer deaths associated with the protocol and provide an unbiased written report of the event to the USAMRMC Office of Research Protections (ORP) Human Research Protections Office (HRPO). At a minimum, the medical monitor should comment on the outcomes of the event or problem and in the case of a serious adverse event of death comment on the relationship to participation in the study. The medical monitor should also indicate whether he/she concurs with the details of the report provided by the P.I. Reports for events determined by either the PI or medical monitor to be possibly or definitely related to participation and reports of events resulting in death should be promptly forwarded to the HRPO. [See also Appendix D]

Consultant (Neil H. Bander, MD): Will provide insight and guidance in overall study design, use of antibody, and correlative studies examining PSMA expression.



Weill Cornell Medical College

└ NewYork-Presbyterian Hospital
└ Weill Cornell Medical Center

John P. Leonard, M.D.

The Richard T. Silver Distinguished Professor of
Hematology and Medical Oncology
Professor of Medicine
Clinical Director, Center for Lymphoma and Myeloma
Chief, Lymphoma/Myeloma Service
Associate Director for Clinical Research, Weill Cornell Cancer Center
Weill Cornell Medical College

Attending Physician
New York Presbyterian Hospital Weill Cornell Medical Center

520 East 70th Street, Starr 341
New York, NY 10065
Telephone: 212-746-2932
Fax: 212-746-3844
Email: jpleonar@med.cornell.edu

June 5, 2009

Scott T. Tagawa, MD
Assistant Professor of Medicine & Urology
Weill Cornell Medical College
525 E. 68th St., Starr 341
New York, NY 10065

Dear Scott,

I am pleased to write this letter in support of your DOD grant application PC081664 entitled "A Randomized Phase 2 Trial of ¹⁷⁷Lu Radiolabeled Monoclonal Antibody HuJ591 (¹⁷⁷Lu-J591) and ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy".

This multicenter trial will be led by you and other WCMC investigators. As Director of the WCMC Hematology and Medical Oncology Clinical Trials office, I will ensure that you will receive the support necessary for conduct of the clinical trial. I am in agreement with the key personnel as outlined in the clinical protocol (Section 15) with additional oversight from Alicia Lewis and Koty Nadeau.

This study is an exciting project. I look forward to collaborative efforts.

Sincerely,

A handwritten signature in black ink, appearing to be "J. Leonard", written over a horizontal line.

John P. Leonard, M.D.



Weill Cornell Medical College

Office Of Research and Sponsored Programs
Grants & Contracts

Mailing Address:
1300 York Avenue, Box 89
New York, NY 10065

Office Location:
425 East 61st Street, Room 223
New York, NY 10065

Telephone: 212-821-0959
Fax: 212-821-0799
E-mail: rasp@med.cornell.edu

March 18, 2009

Shannyn M. Scassero
Contract Specialist
Phone: 301-619-2640

RE: PC081664. PI Scott T. Tagawa, MD

Dear Ms. Scassero,

This is to confirm proposed salaries for the above mentioned project:
Sharmaine Lewis, Regulatory Coordinator: current salary of \$45,000
Dan Matulich, Data Control Coordinator: current salary of 39,561
Kristen Petrillo, RN, Research Nurse: current salary of 80,855

Salaries for these positions were assessed by WCMC HR office in accordance with attached institutional policy 430 Salary Ranges.

Please do not hesitate to contact me at 646-962-8290 with any questions.

Sincerely,

Barbara Pifel by A. Davis 3/18/09

Barbara Pifel, JD, MBA, RN
Associate Dean, Sponsored Programs



Weill Cornell Medical College
Intranet

December 18, 2008

[Calendar](#)

[Email](#)

[Intranet Home](#)

HUMAN RESOURCES

[STAFF DIRECTORY](#)

[OUR DIVISIONS](#)

[POLICIES AND PRACTICES](#)

[FORMS](#)

[LINKS AND IMPORTANT RESOURCES](#)

[Home](#)

430 Salary Ranges

[<< Previous](#) -- [Next >>](#)

[General Information Policies](#)

[Leave and Time Off Policies](#)

[Employment Policies](#)

[Employee Conduct Policies](#)

[Benefits Policies](#)

[Compensation Policies](#)

The Human Resources Department is responsible for developing, implementing and maintaining a Compensation Plan, a system of salary grades with accompanying ranges for the classification of all non-academic positions. Pay for all non-academic employees is administered in accordance with this Plan. Each salary range is divided into quartiles with a range midpoint halfway between the range minimum and maximum.

[search policies](#)

Non-academic salary ranges are reviewed annually to ensure internal and external equity and market parity, and new or revised ranges are implemented as appropriate, usually during the annual budgeting process. Salary ranges are based on survey data obtained from various sources providing relevant salary data and local market trends and from information related to inflationary trends.

New employees should be advised of their grades and ranges by their supervisors at the time of hire. As employees progress through the appropriate ranges during their employment, they should be advised of their positions in the range by their supervisors at the time of their annual review.

APPENDIX E

Budget Justification

Item	Description/Amount	Justification
Tagawa (PI)	5% salary yrs 1-2, 25% salary year 3	5% of effort in recruiting, screening, enrolling, treating subjects, supervising other sites (note additional funding exists for PI salary from other sources during years 1-2); 20% effort in year 3 reflects additional time in verification of data, analysis, interpretation, and reporting
Christos (Statistician)	5% salary years 1-2, 10% salary year 3	Ongoing safety analysis, preliminary analyses of correlative (secondary) endpoints prior to study unblinding, interim analysis, final analyses and reporting
Lewis (Regulatory Coordinator)	50% salary years 1-3	Communicate with DOD (incl HRPO), FDA, IRB; help coordinate potential and enrolled subjects at all sites; coordinate SAE's globally
Matulich (Data Manager)	50% of salary years 1-2, 60% salary year 3	Assist with pre-screening and screening of subjects at WCMC; optimize accurate data collection and entry by communicating frequently with other sites; prepare WCMC SAE/AE's; prepare data for analysis
Petrillo (Research RN)	15% salary years 1-3	Pre-screen and screen subjects; communicate with current and potential subjects at WCMC; assist with study drug administration and monitoring; assist with monitoring of toxicities; assist other sites via phone
Radiolabeled J591	\$2500/dose	J591 manufacturing: \$700/dose; DOTA conjugation: \$200/dose; 177Lu: \$1000/dose; 111In: \$1100/dose; radiolabeling procedure \$300/dose; shipping to site: \$300/dose
J591 scans (WCMC)	\$400 per scan	Performance of scan + reading (anticipate 30 pts at WCMC site)
PSMA Immunohistochemistry	\$150 per pt	DAKO 3E6 immunohistochemistry on unstained paraffin embedded slides on 100 patients (not all will have available tissue)
Shipping	\$150 per pt for CTC's; batched shipping of other correlative studies (\$100 per shipment for frozen specimens; \$34 other)	Shipping of CTC tubes and serum/plasma samples to primary site
Travel	Mandatory DOD meetings	self explanatory (PI +/- coordinator)
Travel	Scientific meetings (PI)	1 domestic meeting per year to discuss/present data
Travel	Site visits (PI, data manager, or coordinator)	Planned site initiations via teleconference, anticipate that 25% of sites will need in-person site initiation. WCMC will monitor the data quality via phone, fax, electronic database throughout the study; anticipate need for site visits to verify validity of data against source documents (site audits). Anticipate at least 1-2 visits per site, one after initial 1-2 subjects treated and one during year 3.

Itemized travel budget for site visits: (per visit)

Transportation to site: Car/Train/Airfare + ground transportation average \$500

Lodging: 0-1 overnight stay per visit: \$300

Food: \$60 per visit (2-4 meals)

(It is understood that travel costs will vary significantly between sites (i.e. travel to sites in northeast vs west will vary in cost))

Joan and Sanford I. Weill
Medical College

Neil H. Bander, M.D.
*Bernard and Josephine Chaus Professor
of Urologic Oncology*

James Buchanan Brady Foundation
Department of Urology
Box 23, Room E-300
525 East 68th Street
New York, NY 10021

Administrative: 212-746-5493
Clinical: 212-746-5460
Fax: 212-746-8941
nhbander@med.cornell.edu
www.nycornell.org/uo/

June 5, 2009

Scott T. Tagawa, MD
Assistant Professor of Medicine & Urology
Weill Cornell Medical College
525 E. 68th St., Starr 341
New York, NY 10065

Dear Scott,

I am happy to write this letter in support of your DOD grant application PC081664 entitled "A Randomized Phase 2 Trial of ¹⁷⁷Lu Radiolabeled Monoclonal Antibody HuJ591 (¹⁷⁷Lu-J591) and ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy".

I understand that you are in negotiations with the DOD to fund a portion of the trial, including the costs of the monoclonal antibody J591 and the radionuclides, some correlative studies, and time and effort for key personnel at WCMC. No DOD funds will be used to support other sites. As director of the WCMC Genitourinary Research Fund, I agree to support the clinical trial with these funds. With the understanding that each site will be urged to apply for additional support via their CTSA, I have reviewed the anticipated study budget which is external to the DOD-supported items and agree to fund the approximate \$529,450 anticipated to complete the study. This will cover start up costs for each site, reimburse site personnel for time/effort in the conduct of the study, and pay for some correlative studies.

This clinical trial is an innovative and important study which may improve the lives of men affected by the most common cancer in men. I look forward to collaborative efforts.

Sincerely,



Neil H. Bander, M.D.
Bernard & Josephine Chaus Professor
Director, Laboratory of Urological Oncology

Weill Cornell Medicine

Institutional Review Board
Mailing Address:
1300 York Avenue Box 89
New York, NY 10065

Telephone: 646-962-8200
E-mail: irb@med.cornell.edu

October 18, 2017

Scott T. Tagawa, MD

Submission Type:	Continuing Review with Amendment
Protocol Number:	0810010067R009
Protocol Title:	A Randomized Phase 2 Trial of Lu Radiolabeled Monoclonal Antibody HuJ591 (Lu-J591) and ketoconazole in Patients with High-Risk Castrate Biochemically Relapsed Prostate Cancer After Local Therapy.
Status of IRB Protocol:	Open
Risk Level:	Greater than Minimal Risk
Amendment Summary:	Remove Irene Karpenko and add Jyothi Sreekumar as the administrative contact. Dr. Himisha Beltran has been removed as a co-investigator.

Dear Dr. Tagawa:

The renewal for the abovementioned protocol was reviewed at the **October 18, 2017** meeting of the Institutional Review Board.

The protocol and its relevant documents stand approved for the following period:

- Consent Form for Clinical Investigation – 2/10/2016
- Subject Materials: Medication Diary, FACT-P
- Recruitment Materials: Information Card, Brochure
- AE & IND Table – 10/3/2017
- DSMB Report – 6/23/2017
- IND Report – 5/3/2017

Approved: 10/18/2017

Expires: 10/17/2018

Please do not hesitate to contact the IRB office staff if you have any questions or need assistance in complying with the terms of this approval.

Sincerely,



Alavy Sos, M.S.
Director, Institutional Review Board

Please note the following important information about this approval:

- No investigators on this study, who also serve as members of the Weill Cornell Medicine IRB, participated in the review, discussion or vote of this submission.
- **Billing Compliance:** This approval is contingent upon continued adherence with institutional billing compliance policies.



Institutional Review Board Mailing Address: 1300 York Ave Box 89, New York, NY 10065 | T. 646.962.8200 | irb@med.cornell.edu

- **Immediate Reporting:** Investigators must follow the Immediate Reporting Policy at http://weill.cornell.edu/research/research_integrity/institutional_review_board/irb_adv.html
- Failure to comply with IRB directives within specified time frames may result in federally mandated penalties, up to and including suspension or termination of IRB approval and mandatory reporting to the Federal government.
- **Human Gene Transfer:** If this is a human gene transfer protocol, it is a term and condition of IRB approval that the principal investigator obtains Institutional Biosafety Committee (IBC) approval of all amendments prior to initiation, reportable adverse events as per WCMC policy, and annual reports as per M-I-C-3 of the NIH Guidelines for Research Involving Recombinant DNA Molecules. View the IBC website at http://weill.cornell.edu/research/research_integrity/ibc.html or contact ibc@med.cornell.edu if you require assistance in complying with these requirements.
- **Other reporting:** The reporting requirements of various regulatory bodies may differ with regard to both what must be reported and when. You are responsible for acquainting yourself with and abiding by all applicable federal and state regulatory reporting requirements.
- **Changes to this protocol:** If you want to change this research in any way or if any unanticipated hazardous conditions emerge affecting the rights or welfare of the human subjects involved in it, you must submit an amendment detailing these changes to the IRB for review and approval prior to implementing those changes. If the CTSC is used, the changes must also be submitted to the Translational Research Advisory Committee (TRAC). It is your responsibility to obtain approval for any such changes prior to initiating them.
- **Continuing approval:** You will receive a reminder via email for continuing review of this protocol in advance of the expiration date. The continuing review forms must be filed with the IRB sufficiently early to permit timely review and approval if the project is to continue beyond the period for which it was approved. Please note, no study related activities can continue beyond the WCMC IRB expiration date, including subject recruitment, enrollment, intervention and data analysis.
- **If your research study involves human tissues:** In addition to IRB approval, Section 4.4 of the hospital By-Laws "Specimens Removed During Resective Surgery" requires that all specimens removed during surgical diagnostic procedures that will be used for research must be approved by Pathology Service. Information about Pathology review can be found online at http://www.med.cornell.edu/research/for_pol/forms/Pathology_Review_Instructions.pdf
- **If the IRB is requiring that you obtain informed consent from subjects:** The signed IRB approved consent forms must be kept in the subject's hospital chart. If the subject has no New York Presbyterian Hospital chart, you are responsible for retaining such signed forms in your research files.
- **Information about the WCMC IRBs:** The Weill Cornell Medical College (WCMC) Institutional Review Board (IRB) is constituted as required by the Federal Office for Human Research Protections (OHRP). WCMC holds a Federalwide Assurance (FWA) with OHRP. The FWA number is FWA0000093. The WCMC IRB is registered on that FWA. The registration number for the IRB is: General IRB #1 IRB00009417, General IRB #2 IRB00009418, Cancer IRB#1 IRB00009420, Cancer IRB#2 IRB00009421 and Expedited IRB IRB00009419. Should you need additional information about the terms of the WCMC FWA or the WCMC IRBs, please refer to http://weill.cornell.edu/research/research_integrity/institutional_review_board/index.html.
- Note that new federal legislation took effect April 7, 2008, (<http://grants.nih.gov/grants/guide/notice-files/NOT-OD-08-033.html>), requiring that all peer-reviewed journal articles resulting from NIH supported research be deposited in PubMed Central, the NIH free digital archive of biomedical and life sciences journal literature, and be made publicly available within twelve months of publication. The Library and RASP have prepared general information which you can see at: <http://library.med.cornell.edu/FacPub/nihpolicy.html>
- **ClinicalTrials.gov:** To comply with applicable requirements (HHS, NIH, and/or ICMJE), you **must** register **prior** to the first subject enrollment for studies that meet the following criteria:
 - Interventional investigator-initiated NIH-funded WCM studies
 - Interventional investigator-initiated WCM studies evaluating at least one FDA-regulated drug, biological, or device product (except for phase 1 and small device feasibility studies)
 - Any research study that prospectively assigns human participants or groups of humans to one or more health-related interventions to evaluate the effects on health outcomes

Updating of the record is required every 6 months, with results reporting required for some studies 12 months after study completion. **Failure to publicly post results may incur civil monetary penalties of up to \$10,000/day.** Email registerclinicaltrials@med.cornell.edu with full name, CWID and phone number to set up a ClinicalTrials.gov account. More information is available at <http://researchintegrity.weill.cornell.edu/clinicaltrialsdotgov.html>.

